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PERFORMANCE OF REMEDIAL RESPONSE
ACTIVITIES AT UNCONTROLLED HAZARDOUS
WASTE SITES (REM II)

DRAFT

PHASE II REMEDIAL INVESTIGATION
DOCUMENTATION REPORT

FOR THE
SOUTHERN MARYLAND WOOD TREATING SITE
HOLLYWOOD, MARYLAND
VOLUME I

August, 1987

Work Assignment No.: 95-3LE8

Document No.: 193-RI2-RT-EZKH

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Work Assignment No.: 95-3LE8

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Subject: Draft Phase II RI Documentation Report for the Southern
Maryland Wood Treating Site.

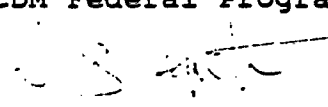
Gentlemen:

CDM Federal Programs Corporation is pleased to submit this Draft
Phase II RI Documentation Report for the Southern Maryland Wood
Treating site in Hollywood, Maryland.

If you have any questions, please contact J.N. Motwani, Site
Manager, Roy F. Weston, Inc. (215-692-3030) or us.

Sincerely yours,

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Roy F. Weston, Inc. (WESTON) is pleased to submit this Draft
Phase II RI Documentation Report for the Southern Maryland Wood
Treating site in Hollywood, Maryland.

If you have any question, please contact us.

Very truly yours,

ROY F. WESTON, INC.


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HOLLYWOOD, MARYLAND

Work Assignment No.: 95-3LE8

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SOUTHERN MARYLAND WOOD TREATING SITE (RI/FS)

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
VOLUME I	
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION	1-1
1.1 Program Overview	1-1
1.2 Site Background Information	1-2
1.2.1 Site Location	1-2
1.2.2 History of Site Operations	1-2
1.3 Nature and Extent of the Problem	1-6
1.3.1 Waste Disposal Overview	1-6
1.3.2 Contaminant Migration Pathways	1-6
1.3.3 Synopsis of Previous Studies/ Remedial Actions	1-10
1.4 Scope and Objectives	1-12
1.5 Report Organization	1-12
2.0 ENVIRONMENTAL SETTING	2-1
2.1 Climate	2-1
2.2 Topography and Surface Drainage	2-3
2.3 Soils	2-3
2.4 Geology	2-6
2.5 Hydrogeology	2-12
2.6 Demography and Land Use	2-14
2.6.1 Population	2-14
2.6.2 Employment	2-16

TABLE OF CONTENTS
(continued)

<u>Section</u>	<u>Page</u>
3.0 SITE INVESTIGATION OVERVIEW	3-1
3.1 General	3-1
3.2 Analytical Field Screening Method Development	3-5
3.3 Geophysical Studies	3-6
3.3.1 General	3-6
3.3.2 Terrain Conductivity	3-8
3.3.3 Ground Penetrating Radar	3-9
3.4 Survey Activities	3-9
3.5 Ground Water Studies	3-11
3.5.1 Ground Water Flow Direction	3-11
3.5.2 Determination of Ground Water Flow Velocity	3-12
3.5.3 On-site Well Construction and Sampling	3-13
3.5.3.1 Well Construction and Development.....	3-13
3.5.3.2 Monitor Well Sampling and Analysis	3-18
3.5.4 Residential Well Sampling	3-18
3.6 Ambient Air Quality	3-21
3.7 Soil Investigation	3-21
3.7.1 General	3-21
3.7.2 Soil Sampling	3-23
3.7.2.1 Soil Boring Sampling	3-23
3.7.2.2 Surface Soil Samples	3-27
3.7.2.3 Test Pit Samples	3-28
3.7.3 Chemical Analysis of Soil Samples	3-29

TABLE OF CONTENTS
(continued)

<u>Section</u>	<u>Page</u>
3.7.3.1 Phase I Soil Samples	3-29
3.7.3.2 Phase II Soil Samples	3-29
3.7.4 Geotechnical Analysis of Soil Samples ...	3-30
3.8 Buildings, Tanks, and Retorts	3-33
3.9 Surface Water and Sediment Studies	3-35
3.9.1 General	3-35
3.9.2 Summary of Sampling and Analysis Activities	3-35
3.9.2.1 Phase I Investigations	3-35
3.9.2.2 Phase II Investigations	3-36
4.0 RESULTS OF THE REMEDIAL INVESTIGATION	4-1
4.1 Geophysical Studies	4-1
4.1.1 Ground Penetrating Radar (GPR) Survey ...	4-1
4.1.2 Terrain Conductivity Survey	4-4
4.2 Ground Water Studies	4-7
4.2.1 Ground Water Flow Direction	4-7
4.2.2 Ground Water Velocity	4-13
4.2.3 Ground Water Quality	4-15
4.2.3.1 Residential Well Water Quality	4-15
4.2.3.2 Shallow On-Site Ground Water Quality	4-15
4.3 Ambient Air Quality	4-20
4.3.1 Real-Time Air Monitoring	4-20
4.3.2 Time-Weighed Average Sampling	4-20
4.4 Soils	4-22
4.4.1 Background Soils	4-23

TABLE OF CONTENTS
(continued)

<u>Section</u>	<u>Page</u>
4.4.1.1 General	4-23
4.4.1.2 Soils Encountered	4-23
4.4.1.3 Analytical Results	4-24
4.4.2 Surface Soils	4-24
4.4.2.1 Objective	4-24
4.4.2.2 Soils Encountered	4-26
4.4.2.3 Analytical Results	4-7
4.4.3 Subsurface Soils	4-33
4.4.3.1 General	4-33
4.4.3.2 Soils Encountered	4-35
4.4.3.3 Geotechnical Testing Results ...	4-41
4.4.3.4 Chemical Analytical Results	4-43
4.4.4 Summary of Soil Investigation	4-46
4.5 Tanks, Retorts, and Buildings	4-47
4.5.1 Buildings	4-47
4.5.2 Tanks and Retorts	4-50
4.6 Surface Water and Sediments	4-52
5.0 ENDANGERMENT ASSESSMENT (Reserved)	5-1
6.0 IDENTIFICATION AND SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES	6-1
6.1 Evaluation Process	6-1
6.2 Remedial Action Objectives	6-3
6.3 General Response Actions	6-3

TABLE OF CONTENTS
(continued)

<u>Section</u>	<u>Page</u>
6.4 Screening of Potential Remedial Technologies ...	6-8
6.4.1 Screening Process	6-8
6.4.2 Technology Screening	6-9
6.5 Order-of-Magnitude Cost Screening	6-63
6.6 Summary of Technologies	6-63
6.7 Development of Remedial Action Alternatives (Reserved)	6-75
7.0 EVALUATION OF REMEDIAL ACTION ALTERNATIVES (Reserved)	7-1
8.0 SUMMARY OF EVALUATION (Reserved)	8-1
9.0 RECOMMENDATIONS AND CONCLUSIONS	9-1

REFERENCES

VOLUME II

- Appendix A - Superfund Process
- Appendix B - Report on Development and Validation of
the UV Fluorescence Screening Method
- Appendix C - Map Sheets
- Appendix D - Slug Test Data and Analysis
- Appendix E - Drilling and Test Pit Logs, and Well
Construction Summaries
- Appendix F - Chemical Data
- Appendix G - Geotechnical Data
- Appendix H - Comparison of UV Fluorescence Screening
with Conventional Analytical Data

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1-1	Area-by-Area Review of Possible Causes of Contamination	1-7
1-2	Potential Migration Pathways at the Southern Maryland Wood Treating Site	1-9
1-3	Summary of Phase I RI Activities	1-13
1-4	Summary of Phase II RI Activities	1-14
2-1	Summary of Temperature and Precipitation Data	2-2
2-2	Generalized Stratigraphy of Southern Maryland	2-9
2-3	Summary of Drilling Log for On-Site Production Well (Inactive) Southern Maryland Wood Treating Site	2-11
2-4	Well Inventory Survey Near Southern Maryland Wood Treating Site	2-15
2-5	Distribution of Employment in St. Mary's County 1982 Annual Average	2-17
3-1	Summary of Phase I RI Activities	3-2
3-2	Summary of Phase II RI Activities	3-3
3-3	Comparison of UV Fluorescence Screening and GC/MS Data for Method Validation	3-7
3-4	Summary of Well Construction	3-16
3-5	Summary of Residential Wells Sampled	3-20
3-6	Summary of RI Phase II Soil Samples	3-26
3-7	Summary of Geotechnical Analytical Program	3-32
3-8	Summary of RI Phase II Surface Water and Sediment Sampling and Analysis Program	3-40

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
4-1	RI Phase I Water Level Elevations	4-8
4-2	RI Phase II Water Level Elevations	4-10
4-3	Summary of Analytical Results for Ground Water Samples	4-16
4-4	Summary of Analytical Results for Background Soil Samples	4-25
4-5	Summary of Analytical Results of Surface Soils	4-28
4-6	Organic Compounds Most Frequently Identified in Surface Soil Samples	4-30
4-7	Summary of Dioxin/Furan Results for Surface Soil Samples	4-31
4-8	Relative Percentages of Chlorinated Dibenzo- Dioxin and Dibenzofuran Congeners in Surface Soils	4-34
4-9	Summary of Results of Geotechnical Analyses for RI Phase II Soil Samples	4-42
4-10	Summary of Analytical Results of Subsurface Soils by Area	4-44
4-11	Organic Compounds Most Frequently Identified in Subsurface Soil Samples	4-45
4-12	Approximate Volume of Soils Requiring Treatment at Various Total PNA Concentrations	4-48
4-13	Summary of Tank Sampling and Analysis Program	4-51
4-14	Relative Percentages of Chlorinated Dibenzo- dioxin and Dibenzofuran Congeners in Tank Samples	4-53

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
4-15	Summary of Surface Water and Sediment Analytical Results	4-54
4-16	Most Frequently Identified Organic Compounds In Surface Water and Sediments	4-57
4-17	Summary of Dioxin/Furan Results for Surface Water and Sediment Samples	4-59
4-18	Relative Percentages of Chlorinated Dibenzodioxin and Dibenzofuran Congeners in Surface Water and Sediment Samples	4-60
6-1	General Response Actions and Associated Remedial Technologies	6-5
6-2	Relative Order-of-Magnitude Costs for Remedial Technologies Applicable to the Southern Maryland Wood Treating Site	6-64
6-3	Summary of Technology Screening for the Southern Maryland Wood Treating Site	6-68
9-1	Comparison of Contaminant Solubility With Frequency of Occurrence for Southern Maryland Wood Treating Site	9-3

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
ES-1	Map Depicting the Area where Monitor Well Samples Contained Greater than 20 ppb Total PNAs	ES-5
1-1	Site Location	1-3
1-2	Location of the Southern Maryland Wood Treating Site on U.S.G.S. 15' Quadrangle	1-4
1-3	Site Sketch	1-5
1-4	Site Sketch Depicting Areas Discussed in Table 1-1	1-8
2-1	Wind Rose	2-4
2-2	Topographic Map of the Southern Maryland Wood Treating Site	2-5
2-3	Detailed Soil Group Types in the Vicinity of the Southern Maryland Wood Treating Site	2-7
2-4	Geologic Cross Section Through Southern Maryland Wood Treating Site	2-10
3-1	Typical GPR Profile	3-10
3-2	Monitor Well Locations	3-14
3-3	Locations of Residential Wells Sampled During RI Phase II	3-19
3-4	Locations of Sampling Stations for Time- Weighted Average Air Sampling	3-22
3-5	Phase I Soil Sampling Locations	3-24
3-6	Phase II Soil Sampling Locations	3-25
3-7	Locations of Tanks, Buildings, and Retorts	3-34
3-8	Phase I Surface Water/Sediment Sampling Locations	3-37
3-9	Phase II Surface Water/Sediment Sampling Locations	3-38
4-1	Interpretive Map of the Subsurface Based on the Ground Penetrating Radar Results	4-2

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LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
4-2	Interpretive GPR Map of Subsurface Showing Discrete Buried Objects	4-3
4-3	EM Data - Horizontal Dipole Mode	4-5
4-4	EM Data - Vertical Dipole Mode	4-6
4-5	Water Table Map - 25 October 1985 Data	4-9
4-6	Contour Map of Ground Water Level Elevations Based on 8/86 Measurements	4-11
4-7	Map Depicting the Area where Monitor Well Samples contained Greater Than 20 ppb Total PNAs	4-17
4-8	Sampling Locations for Mini-RAM	4-20
4-9	Site Sketch Depicting Areas Listed in Table 4-5	4-29
4-10	Plan View Depicting Locations of Stratigraphic Cross Sections Represented in Figures 4-11, 4-12, and 4-13	4-36
4-11	Generalized Stratigraphic Cross Section A-B	4-37
4-12	Generalized Stratigraphic Cross Section C-D	4-38
4-13	Generalized Stratigraphic Cross Section E-F	4-39
4-14	Elevation Contour Map of the Top of the Clay and Silt Layer	4-40
4-15	Locations of On-Site Buildings	4-49
4-16	Surface Water and Sediment Sampling Locations	4-55
6-1	Surface Water Management Controls	6-13
6-2	Typical Multilayer Cap System Profile	6-23
6-3	Rotary Kiln Incinerator Schematic	6-42
9-1	Proposed Additional Sampling and Monitor Well Locations	9-5

EXECUTIVE SUMMARY

GENERAL

This report describes the results through Phase II of the Remedial Investigation/Feasibility Study (RI/FS) at the Southern Maryland Wood Treating (SMWT) site in Hollywood, Maryland. The report summarizes the data acquired during the Phase I and Phase II RI activities, identifies the data requirements to be investigated during the proposed Phase III RI Study, and develops preliminary screening of applicable remedial technologies based on the RI data.

The RI/FS was performed in accordance with U.S. EPA Contract No. 68-01-6939, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as Superfund and the Superfund Amendments and Reauthorization Act of 1986 (SARA). Roy F. Weston, Inc. (WESTON) was the lead contractor for this investigation.

INTRODUCTION

The SMWT facility was operated by the L.A. Clarke and Sons, Inc. as a pressure treatment facility for wood between 1965 and 1978. Available information indicates that creosote and pentachlorophenol (PCP) were used as wood treatment preservatives at the facility. Wood treatment activities were discontinued in 1978.

Presently, a portion of the site is being leased to Ridge Marine Sales (Ridge, MD) and used as a retail outlet for pretreated lumber and crab traps. Wood treatment is no longer being performed at the site.

PRIMARY AREAS OF CONCERN

A review of existing information identified the following waste disposal areas of concern at the SMWT site:

- The former area of six unlined lagoons used for waste disposal during wood treatment activities. These lagoons were excavated as part of the remedial action performed by L.A. Clarke and Sons.
- An on-site freshwater pond which had become contaminated through surface drainage and/or ground water discharge from the area of the lagoons.
- A wooded area used for spray irrigation of lagoon supernatants (liquids) during the L.A. Clarke and Sons remedial action.
- An area used for land treatment of the materials excavated from the lagoons by contractors representing L.A. Clarke and Sons.
- The former wood processing area which had become contaminated through inadequate waste disposal and housekeeping practices.
- The northern portion of the site which was used as a storage location for finished products. Excess preservative may have dripped from the wood onto the ground.
- Building and tanks.

REMEDIAL INVESTIGATION SCOPE OF WORK

The primary objectives of the Phase I RI at the SMWT site were as follows:

- Determine the location of Phase II sampling stations.
- Develop and validate a rapid turn-around field screening method for polynuclear aromatic hydrocarbons (PNAs).
- Focus the Phase II analytical requirements.

The Phase I RI objectives were accomplished by completing the following field investigation activities:

- Geophysical surveys using ground penetrating radar and terrain conductivity methodologies.
- Determination of ground water flow rate and direction from existing on-site wells.
- Development and validation of a UV fluorescence screening method for PNAs through literature studies, laboratory trials and comparative testing.
- Collection and analysis of soil and sediment samples from areas expected to be highly contaminated.

The primary objectives of the Phase II RI at the SMWT site were as follows:

- Determine the nature, extent, and sources of site contamination.
- Identify contaminant migration pathways.

The Phase II RI objectives were accomplished through the following field investigation activities:

- Soil sampling using backhoe test pits and soil borings.
- Sampling of tanks and retorts.
- Topographic surveying of the site in order to prepare a base map, establish ground water contours, and define the site topography.
- Sampling of potential migration pathways: surface water, sediment, ground water and air.

CONCLUSIONS OF THE REMEDIAL INVESTIGATION TO DATE

- The concentrations of Hazardous Substance List (HSL) volatile organics, pentachlorophenol, and PNAs were non-detectable in all time-weighted average air samples except the sample collected near the tanks in the northeast of the site. This sample was found to contain naphthalene at a concentration of 0.003 mg/m³ in air.

- Surface water bodies on and near the site (freshwater pond, west tributary, east tributary) receive water from the on-site ground water. Samples of surface water from the freshwater pond and the west tributary contained volatile organics, PNAs, pentochlorophenol, and other semivolatile compounds at distances up to 1,900 feet downstream of the pond.
- Levels of volatile organics, PNAs, and PCP were below detection limits in samples of surface water from the east tributary.
- Sediment samples from the freshwater pond and west tributary were found to contain PNAs as far downstream from the site as 7,125 feet. This sample contained an estimated 41 ug/kg of fluoranthene.
- Approximately 11,960 gallons of dioxin contaminated waste are contained in tanks on-site. Another 2,140 gallons of tanked waste contained no dioxins but do contain volatile organic compounds and/or PNAs.
- Shallow ground water contamination on-site appears to be localized to an area bounded by the process area, the freshwater pond, and the area to the east of the excavated lagoons. This area is depicted in Figure ES-1. The ground water contaminants tend to be PNAs and acid extractable organics (phenol and cresols).
- Most of the organic compounds detected in the shallow ground water are either soluble or heavier than water. Floating organic contaminants may be present, but the concentration ranges of these contaminants are low relative to those of the soluble and sinking organic contaminants.
- Some compounds were detected in ground water at concentrations in excess of their solubilities. Oily materials found in ground water in this area may contain contaminant concentrations higher than those of the water phase.
- A layer of stained soils was encountered in the saturated soils just above the silt and clay layer in the area where the highest ground water contamination concentrations were found. Soil samples collected from this stain were found to contain PNAs, PCP, and acid extractable organics.

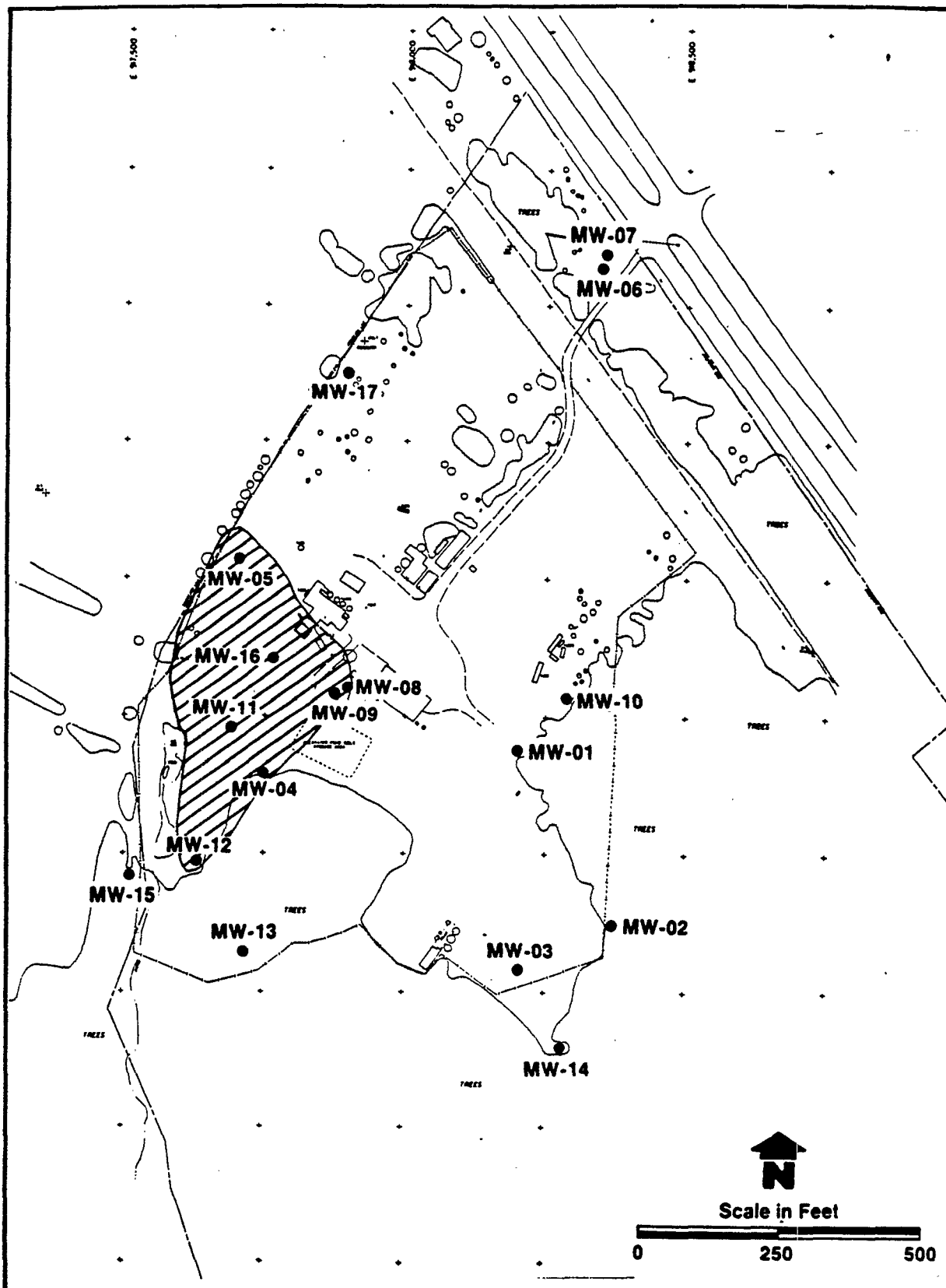


FIGURE ES-1 MAP DEPICTING THE AREA WHERE MONITOR WELL
SAMPLES CONTAINED GREATER THAN 20 ppb TOTAL PNAs

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- Organic contamination in surface soils does not follow any specific pattern and does not appear limited to any specific area. These results are consistent with the operating history and remedial activities that have occurred at the site.
- No tetrachlorodibenzo dioxins were found in any of the samples analyzed for dioxins. Most of the dioxins and furans found in site soils, sediments, tank wastes, surface water, and ground water were the less toxic octa- and hepta-chlorinated congeners.
- The UV fluorescence field screening for PNAs was useful in developing soil volume estimates based on an order-of-magnitude relationship between screening and conventional analytical methods. The UV fluorescence screening method was especially useful in identifying samples with PNA levels below the Contract Laboratory Program (CLP)-Routine Analytical Services contract required detection limits.
- The compounds with the highest solubilities in water (i.e., phenol, 2,4-dimethylphenol, naphthalene, pyrene, fluoranthene, acenaphthylene, acenaphthene) were the compounds found most frequently in ground water and surface water. These high solubility compounds were found in subsurface soils in greater frequencies and concentrations than in surface soils. This supports the conclusion that these compounds are migrating downward through the soils and traveling with the ground water.
- The lower solubility compounds (i.e. benzo(a)anthracene and benzo(a)pyrene) were found in greater frequency and higher concentrations in surface soils and sediments. This supports the conclusion that surface runoff/erosion is a migratory pathway especially for the lower solubility site contaminants.
- No contaminants were detected in residential well samples.

ADDITIONAL DATA NEEDS

Based on a review of the physical and chemical testing results, additional data are required as part of the Phase III activities prior to completion of the Public Health Evaluation/Endangerment

Assessment and the selection of remedial alternatives. These activities include:

- A second round of ground water sampling to confirm the results of the previous sampling.
- Installation and sampling of additional monitor wells to define the ground water flow direction near the fresh-water pond and to evaluate the potential for contaminant migration to deeper water-bearing zones.
- Additional sampling of subsurface soils for geotechnical analyses. These results will be used to establish the technical feasibility and construction and maintenance details for interceptor trenches and slurry walls.
- Collection of additional samples for dioxin/furan analyses. Samples from the process buildings, subsurface soils, and ground water are needed to define remedial options.
- Completion of the Public Health Endangerment Evaluation Assessment to define action levels for remediation.
- Completion of a bench and/or pilot scale testing program to determine the technical feasibility of in-situ bioreclamation as a remedial option.

PRELIMINARY REMEDIAL OBJECTIVES

The objectives of the remedial action at the SMWT site are as follows:

- Contain, reduce or eliminate the threat from the organic contamination present in sediments in the pond and in the tributaries to the appropriate cleanup level and prevent an off-site threat due to migration of contaminants via the sediment migration pathway.
- Reduce or eliminate organic contamination from site soils to appropriate cleanup levels.

- Reduce or eliminate the threat from organic contamination present in surface water and in the shallow ground water aquifer, in the area between the process area and the pond, to appropriate cleanup levels, through implementation of soils/sediment and ground water remediation.
- Reduce or eliminate the threat from existing contaminated buildings, storage/process tanks and process equipment through demolition/remediation of those and any associated organic contaminant contents.

PRELIMINARY SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES

Based on the RI results, data evaluation, and preliminary remedial objectives, several general response actions and associated remedial technologies have been identified for the SMWT site. The technologies have undergone preliminary screening based primarily on technical criteria. Environmental, public health, institutional, and cost considerations were also utilized in the screening process.

The technologies that have been retained for use in developing remedial action alternatives are:

- No action with security upgrade and monitoring.
- Regrading, revegetation, and water diversion.
- Sedimentation basins and ponds.
- Synthetic membrane cap.
- Low-permeability soil cap.
- Asphalt or concrete cap.
- Multilayer cap.
- Ground water containment techniques.
- Ground water pumping.
- Interception trenches, ditches, drains.
- Complete or partial removal of wastes.
- In situ biological treatment.
- Chemical soil flushing
- In situ vitrification.

- On-site incineration.
- Thermal pyrolysis.
- Soil washing/extraction.
- Oxidation/reduction.
- Activated carbon adsorption.
- Land farming/composting.
- Aerobic biological treatment.
- Anaerobic biological treatment.
- Stabilization.
- Off-site incineration.
- Off-site disposal.
- On-site disposal.

1.0 INTRODUCTION

1.1 PROGRAM OVERVIEW

In March 1985, the U.S. Environmental Protection Agency (EPA) issued Work Assignment No. 95-3LE8 as part of Contract No. 68-01-6939 to the REM II project team to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the Southern Maryland Wood Treating (SMWT) site in Hollywood, Maryland. The REM II team assigned Roy F. Weston, Inc. (WESTON) as the lead contractor for this investigation.

EPA has authority to conduct remedial response activities at uncontrolled hazardous waste sites by regulations established under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), more commonly known as Superfund. These authorities were extended and modified by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The site scored a 48.77 based on the Hazard Ranking System. This score is above the 28.5 cutoff used in the past for inclusion on the National Priority List (NPL). The site was included in the October 1984 NPL. The site is ranked 527th out of 703 sites on the June 1986 NPL, making the SMWT site a Group II site. Subsequently, EPA conducted an investigation of current and past site owners/operators to determine the potentially responsible parties for the contamination identified at the site. EPA issued an Action Memorandum in March 1985 and the site RI/FS was pursued as a fund lead site.

A detailed discussion of the RI/FS process and its relationship to the REM II program is presented in Appendix A.

1.2 SITE BACKGROUND INFORMATION

1.2.1 SITE LOCATION

The SMWT site is located off Route 235 in Hollywood, St. Mary's County, Maryland, at latitude $38^{\circ}21'15''$ N and longitude $76^{\circ}35'20''$ W. The site comprises approximately 25 acres in the northwest portion of a 96 acre property. About four acres were previously devoted to a wood treatment operation. The site is surrounded by residential and agricultural areas.

A regional map (Figure 1-1) shows the location of the site with Baltimore, MD and Washington, D.C. situated about 75 miles due north and 50 miles due northwest of the site, respectively. Figure 1-2 shows the location of the site on a USGS topographic quadrangle (Hollywood, MD quadrangle). A site sketch (Figure 1-3) indicates the locations of various structures and surface water bodies on the site, as well as the property boundary.

1.2.2 HISTORY OF SITE OPERATIONS

The SMWT facility was operated by L.A. Clarke and Sons, Inc. as a pressure treatment facility for wood between 1965 and 1978. Available information indicates that creosote and pentachlorophenol (PCP) were used as wood preservatives at the facility. Wood treatment activities were discontinued in 1978.

Presently, a portion of the site is being leased to Ridge Marine Sales (Ridge, MD) and used as a retail outlet for pretreated lumber and crab traps. Wood treatment is no longer being performed at the site.

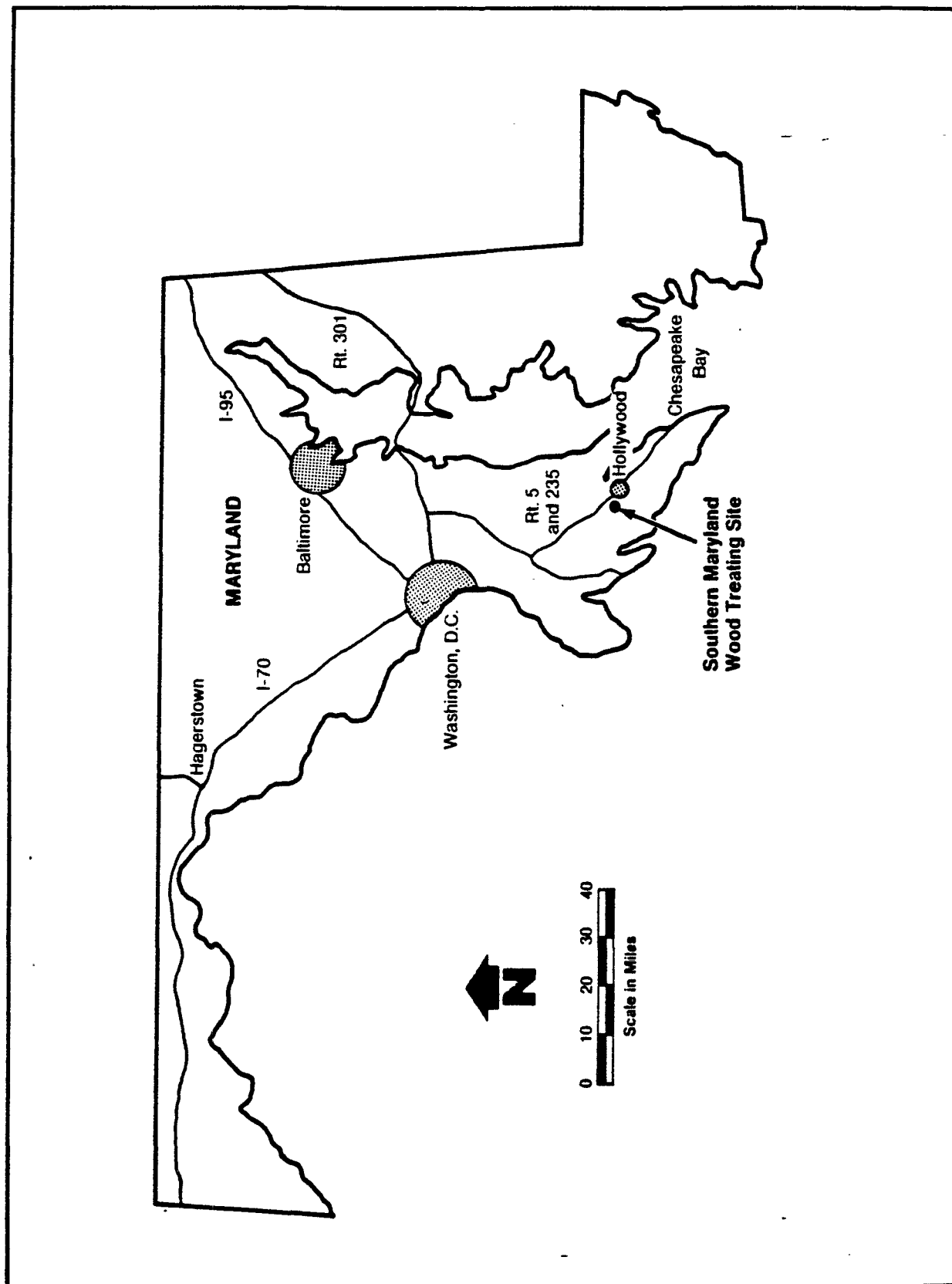


FIGURE 1-1 SITE LOCATION

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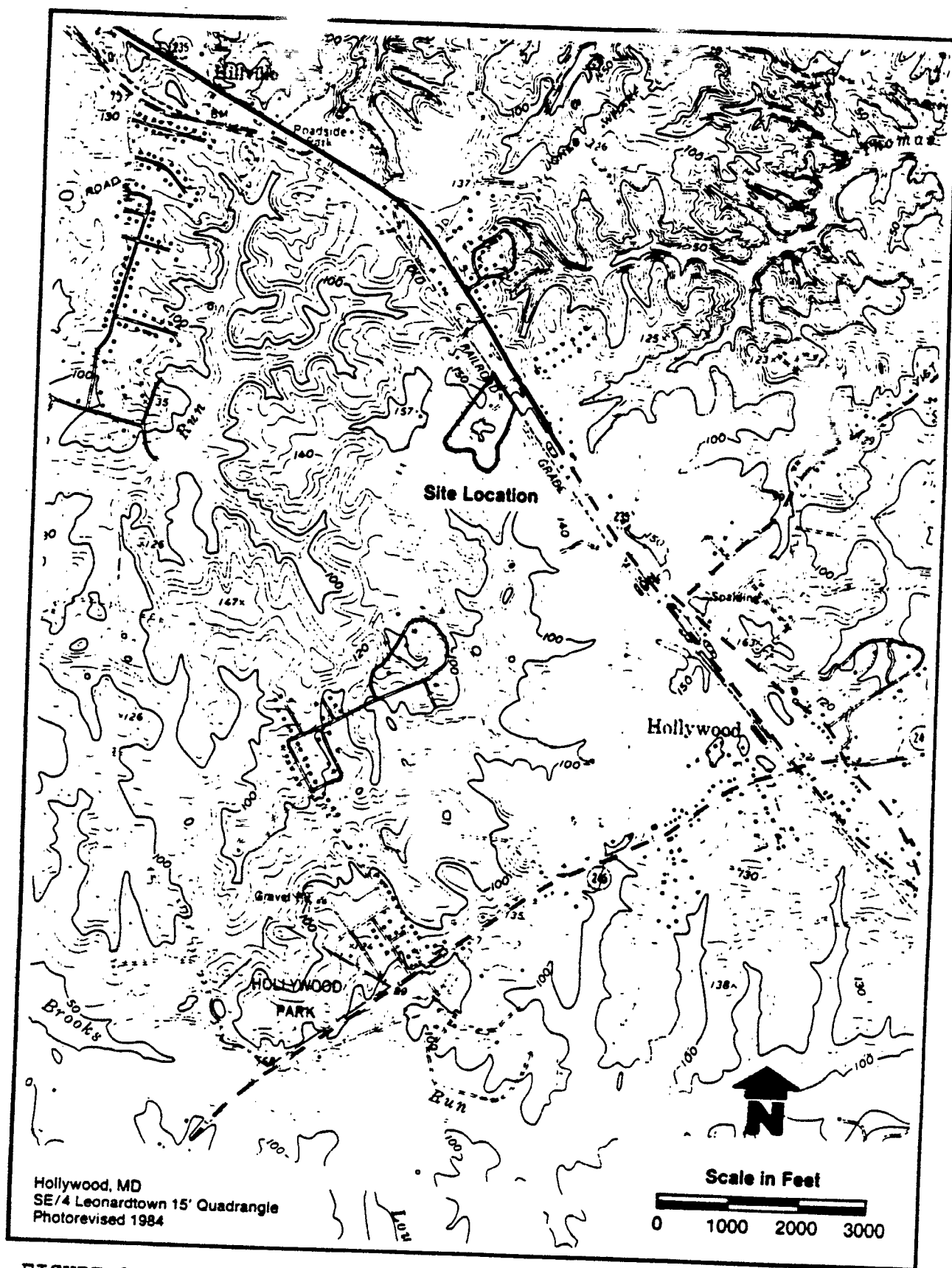


FIGURE 1-2 LOCATION OF SMWT SITE ON USGS 15' QUADRANGLE

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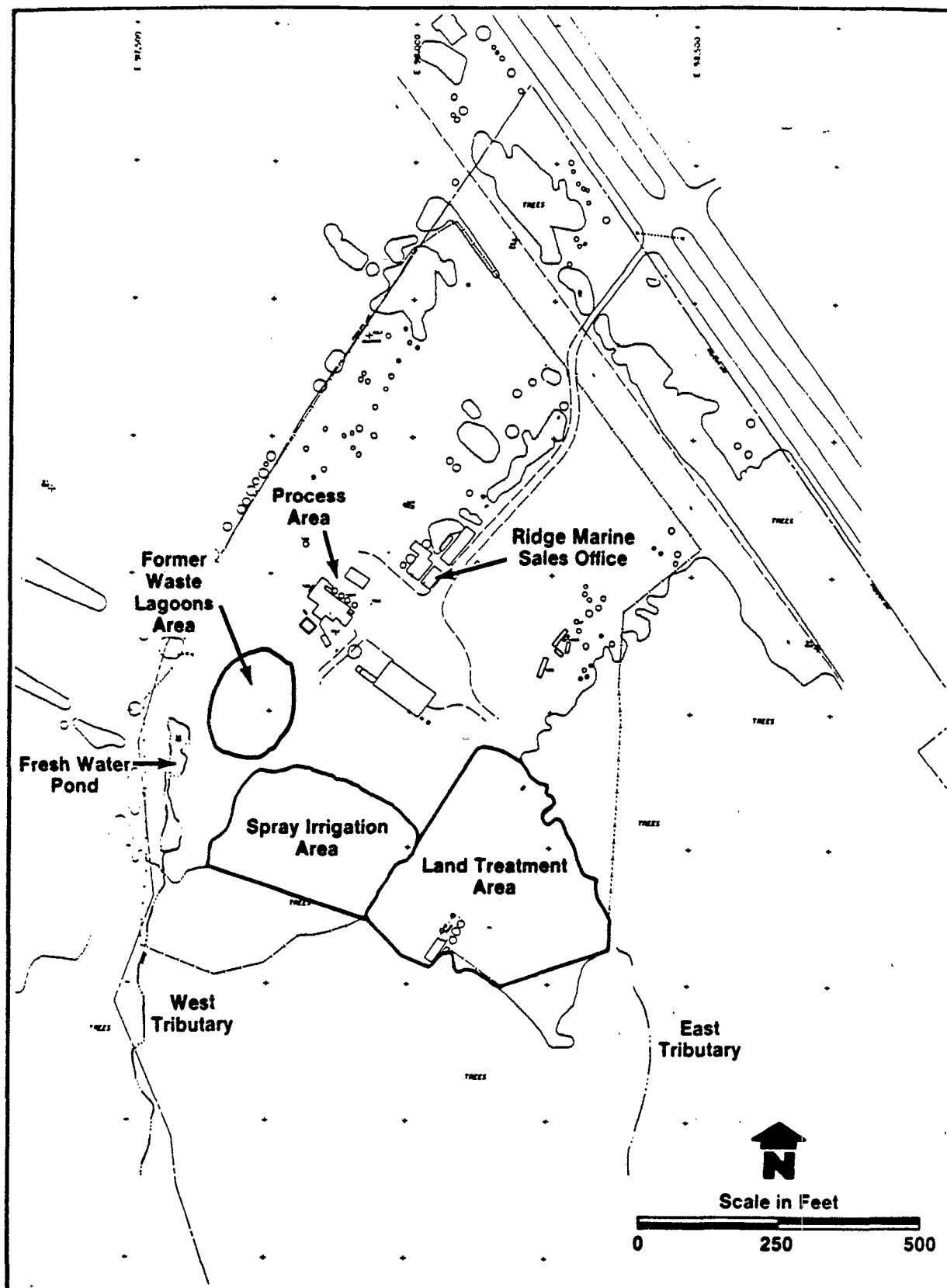


FIGURE 1-3 SITE SKETCH

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1.3 NATURE AND EXTENT OF THE PROBLEM

1.3.1 WASTE DISPOSAL OVERVIEW

The wastes generated at the facility included retort and cylinder sludges, process wastes and material spillage. These wastes were disposed of in six unlined lagoons on-site. An on-site freshwater pond became contaminated with sludges and waste water during the facility's active and subsequent inactive periods. This freshwater pond receives surface runoff from much of the site. The freshwater pond discharges directly to the west tributary which flows into Brooks Run. Brooks Run drains into McIntosh Run. The freshwater pond and west tributary were depicted in Figure 1-3.

Pursuant to legal actions taken by the Maryland Department of Health and Mental Hygiene, the potentially responsible party (PRP), L. A. Clarke & Sons, Inc., initiated clean-up actions at the site in 1982. Liquids from the lagoons were spray irrigated onto the nearby woods. The six waste lagoons were excavated and the area was backfilled and graded. In addition, the freshwater pond was at least partially excavated. The excavated sludges were mixed with wood chips, activated sewage sludge, top soil and grass seed and spread in a land treatment area on the eastern part of the property.

Table 1-1 details possible causes of contamination on an area-by-area basis. Figure 1-4 depicts the areas discussed in Table 1-1.

1.3.2 CONTAMINANT MIGRATION PATHWAYS

Field observations and assessment by the REM II team during the initial site visit in April 1985 identified a number of potential contaminant migration pathways at the SMWT. Table 1-2 summarizes

TABLE 1-1

AREA-BY-AREA REVIEW OF POSSIBLE CAUSES OF CONTAMINATION

<u>AREA</u>	<u>POSSIBLE CAUSES OF CONTAMINATION</u>
● Upper Site	● Drillage from treated wood during storage.
● Northeast Area	● Drillage from treated wood during storage. ● Leakage from tanks.
● Process Area	● Retort waste disposal practices. ● Raw material spillage. ● Drillage from treated wood during transport. ● Inadequate housekeeping practices.
● Excavated Lagoons	● Waste disposal practices.
● Freshwater Pond	● Surface drainage from lagoons. ● Transport of contaminants from lagoons via ground water.
● Spray Irrigation Area	● Spray irrigation of lagoon supernatants.
● Land Treatment Area	● Land Application of lagoon sludges.

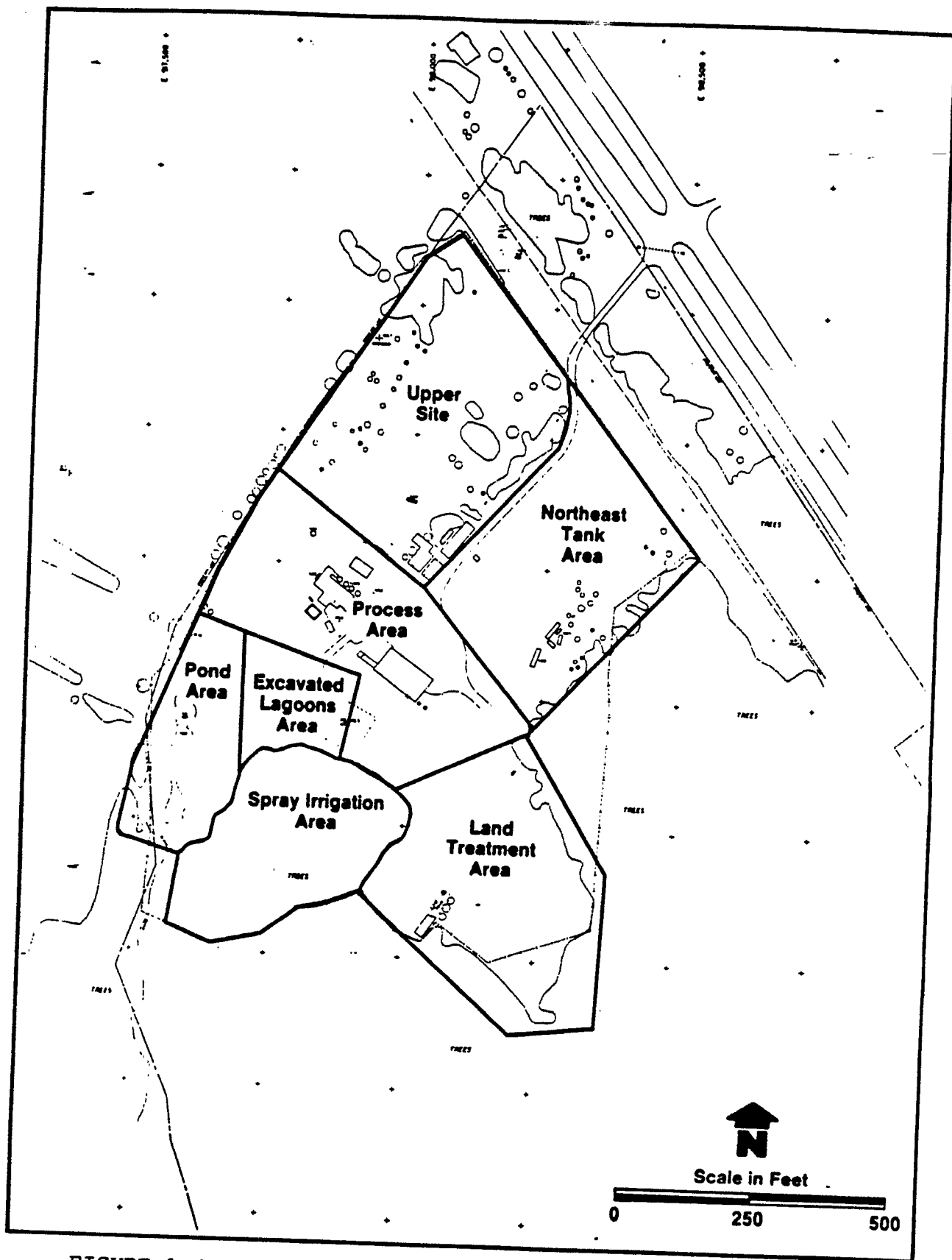


FIGURE 1-4 SITE SKETCH DEPICTING AREAS DISCUSSED IN TABLE 1-1

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TABLE 1-2

POTENTIAL MIGRATION PATHWAYS AT THE
SOUTHERN MARYLAND WOOD TREATING SITE

Pathway	Potential Receptors	Potential Sources	Sampled Previously	Potential Degree of Contamination
Air	Wildlife/ Residents	Tanks, Pond, Surface Soils	Yes	Trace (less than 1.0 ppb) concentrations of creosote along site perimeter.
Ground Water	Residents via water wells, streams.	Contaminated soils, residual sludges from old lagoons and pond.	Yes	PNA and Pentachlorophenol concentrations detected in on-site ground water.
Surface Water	Wildlife	Contaminated soils via runoff/erosion, contaminated ground water and freshwater pond.	Yes	Surface water/sediment samplings along tributary draining the freshwater pond (West Tributary) have detected PNAs and phenols.

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these pathways, whether the pathways had been sampled previously, the potential degree of contamination, and potential sources and receptors.

1.3.3 SYNOPSIS OF PREVIOUS STUDIES/REMEDIAL ACTIONS

A number of site investigations and sampling expeditions have been conducted at the SMWT site following the cessation of operations at the facility. Highlights of these investigations are described below.

- August 1982 - A field investigation was conducted by the EPA Region III Field Investigation Team (FIT) on August 19, 1982. The field investigation included sampling of domestic wells, monitoring wells, surface waters, soils, and sediments. The analytical results revealed contamination from polynuclear aromatics (PNAs) in the west tributary, the soils in the treatment area, sediments in the freshwater pond and one of the monitoring wells.
- October 1984 - An initial site assessment was conducted by the U.S. EPA Region III Technical Assistance Team (TAT) on October 10 and 18, 1984. The site assessment included sampling of soils, sediments, surface water, and domestic wells. The analytical work was performed by a private laboratory. A QA/QC review of the analytical data revealed that the data could not be validated. Therefore, the results (indicating contamination of surface water, sediments, and a domestic well) were considered invalid. Further sampling was scheduled.
- December 1984 - The TAT sampled domestic wells on December 5, 1984 and the samples were analyzed for cadmium and lead. The results of all samples except one domestic well (J. Miedzinski) were below the method detection limit. The concentration of cadmium (0.0004 ppm) in the sample from J. Miedzinski's well was below the drinking water standard.
- January 1985 - On January 15 and 16, 1985, the On-Site Coordinator (OSC), the U.S. EPA Environmental Response Team (ERT), and TAT conducted another assessment at the site. Samples from tanks, soil cores, sediments, surface waters and monitoring wells were collected for chemical and Microtox analyses. Samples were collected along three transects across the site. These samples

confirmed contamination from polynuclear aromatics and pentachlorophenol in the surface water and sediments of the freshwater pond and west tributary, on-site soils, and ground water from an on-site monitor well. Tank sludge samples were found to contain chlorinated dibenzodioxins. Only hexa-, hepta-, and octa-congeners of chlorinated dioxin were identified.

- March 1985 - On March 14, 1985 the OSC initiated an Immediate Removal Action at the site. An extensive site investigation program including soil borings, water and sediment samples, ground water elevation measurements and sampling was initiated as part of the removal action. The TAT collected over 350 samples (soils, sediments, tank solids, surface water and ground water). Samples were analyzed on-site using a field laboratory equipped with a GC/MS/MS (TAGA-6000 SCIEX). Analyses were performed for several parameters including creosol, naphthalene, phenanthrene, pentachlorophenol, phenol, tetrachlorophenol, and hexachloro-dibenzo- dioxins and furans. The data indicated a widespread distribution of contaminants throughout the site.

Polynuclear aromatics (PNAs) and phenolics were found at the site, with the highest concentrations detected in samples from the process area, former lagoon area, land treatment area, and spray irrigation area. Surface water and sediment samples from the west tributary indicated PNA contamination. Dioxins and furans were detected in soil samples from the process area, land treatment area and in the vicinity of the tanks in the eastern part of the site. Ground water analyses from on-site wells and piezometers showed concentrations of total PNAs and phenolic compounds in excess of 1 ppm. These monitor wells are installed in the shallow water table aquifer.

- April 1985 - As part of the Immediate Removal Action, straw filter fences were installed to control downstream migration of sediments along the west tributary.
- January 1986 - As part of the Immediate Removal Action, approximately 1400 yd³ of soil were excavated from the northeastern bank of the freshwater pond and stored on-site. The excavated soils were placed onto a synthetic liner to the east of the former lagoon area. A synthetic cover was placed over the staged soil. The stored soil is still at the site.

1.4 PROJECT SCOPE AND OBJECTIVES

The SMWT RI/FS is being performed in a phased manner. The results of each phase are used to focus data requirements of successive phases and provide support to the remedial alternative analysis.

The objectives and scope of the Phase I and Phase II RI are detailed in Tables 1-3 and 1-4 respectively.

The information obtained during the RI will be applied to accomplish the primary objectives of the FS summarized below:

- Identify/develop standards and criteria as required for contaminant clean-up.
- Identify technological options as required for preventing migration of contaminants beyond site boundaries and eliminating contaminant sources.
- Evaluate remedial alternatives consistent with the National Contingency Plan and other applicable, relevant and appropriate regulations and criteria.

1.5 REPORT ORGANIZATION

This report presents the results of the RI/FS investigation in an integrated fashion. It summarizes the RI effort to date and the initial remedial alternative assessment for the SMWT site. The report is prepared in a format that will facilitate revision as additional data becomes available and new tasks are performed. The RI portion of this report presents:

- Site background information.
- The scope and results of the RI activities to date.

TABLE 1-3

SUMMARY OF PHASE I RI ACTIVITIES

<u>Objective</u>	<u>Scope Activities</u>
<ul style="list-style-type: none">• Determine the location of monitor wells and soil sampling locations.	<ul style="list-style-type: none">• Geophysical investigation using Ground Penetrating Radar and Terrain Conductivity.
<ul style="list-style-type: none">• Define analytical requirements.	<ul style="list-style-type: none">• Determine ground water flow rate and direction from existing on-site wells.
<ul style="list-style-type: none">• Develop and validate a rapid-turnaround field screening method for PNAs.	<ul style="list-style-type: none">• Collection of two soil samples and one sediment sample from areas expected to be highly contaminated. Analysis of these samples for Hazardous Substance List (HSL) organics, HSL inorganic parameters and cyanide, pesticides, and polychlorinated biphenyls (PCBs).
	<ul style="list-style-type: none">• Develop and validate the extraction and analytical techniques with three soil/sediment, and one surface water sample.

TABLE 1-4
SUMMARY OF PHASE II RI ACTIVITIES

<u>Objective</u>	<u>Scope Activities</u>
<ul style="list-style-type: none"> ● Characterize on-site and local air quality. 	<ul style="list-style-type: none"> ● One round of air sampling and analysis for volatile organic compounds, PNAs and pentachlorophenol. ● Real-time air monitoring for volatile organics using HNU and/or OVA and respirable dust using mini-RAM.
<ul style="list-style-type: none"> ● Define the type, degree and extent of soil contamination. Understand the local stratigraphy. 	<ul style="list-style-type: none"> ● Construction of soil borings and test pits, and collection of soil samples. ● Analysis of soil samples by PNA screening, laboratory chemical, and geotechnical methods.
<ul style="list-style-type: none"> ● Define the type, degree and extent of shallow ground water contamination. Define shallow ground water flow direction. 	<ul style="list-style-type: none"> ● Installation of monitor wells. ● Analysis of ground water samples by PNA screening and laboratory chemical methods.
<ul style="list-style-type: none"> ● Investigate whether local residential wells have been affected by SMWT site contaminants. 	<ul style="list-style-type: none"> ● Sampling and analysis of selected residential wells.
<ul style="list-style-type: none"> ● Evaluate the role of surface waters as a contaminant migration pathway. 	<ul style="list-style-type: none"> ● Sampling of surface waters and sediments from the east and west tributaries, Brooks Run and McIntosh Run. Analysis of samples by PNA screening and laboratory chemical methods.
<ul style="list-style-type: none"> ● Characterize the quantities and types of materials in on-site tanks. 	<ul style="list-style-type: none"> ● Sampling and analysis of tanks, and volumetric determination of tank contents.

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Section: 1
Revision: 1
Date: August 1987
Page: 15

Based on the available data, a preliminary FS is presented that addresses:

- Site remediation considerations.
- Initial identification and screening of remedial action technologies.

An evaluation of remedial action alternatives based upon the results of an endangerment assessment will be provided once additional data is acquired. The additional data needs are identified based on the results of the investigation to date and are discussed in more detail in Section 9.0 of this report.

2.0 ENVIRONMENTAL SETTING

2.1 CLIMATE

St. Mary's County is characterized by a continental type climate with well defined seasons. The modifying influence of the nearby Chesapeake Bay and Potomac River moderates extreme temperatures.

The warmest period of the year is during late July. Summer temperatures average 76°F but temperatures of 90° or higher are not uncommon. The coldest period of the year is at the end of January and the beginning of February. Winter temperatures average 38°F. The average duration of the frost-free period is 201 days (St. Mary's County Chamber of Commerce, 1986).

The average annual precipitation is 39.5 inches, which is distributed relatively uniformly throughout the year. Summer rainfall occurs mostly in moderate to heavy showers and thunderstorms. Tropical storms or hurricanes may also result in unusually high one or two day rainfall totals. Heavy precipitation during the colder part of the year is the result of low-pressure systems moving north or northeast along the coast. The average annual snowfall is 16.3 inches. On average, 13 days per year have measurable amounts of snow cover.

Drought may occur at any time throughout the year, but serious drought is most likely to occur in the summer. During some years, irrigation may be necessary as a result of occasional dry periods during critical stages of crop development. Table 2-1 provides a summary of annual precipitation and temperature data.

Prevailing winds are from the northwest except during the warm part of the year when they become more southerly. The average

TABLE 2-1

SUMMARY OF TEMPERATURE AND PRECIPITATION DATA

Temperature (a)			Precipitation (b)		
Average Daily Maximum (°F)	Average Daily Minimum (°F)	Daily Average (°F)	Average Number of Days with Measurable Amounts	Monthly Average Precipitation (inches)	Monthly Average Snowfall (inches)
January 43.4	29.0	36.2	11	3.14	5.08
February 45.6	29.9	37.8	9	2.76	4.90
March 53.8	37.2	45.5	11	3.53	2.87
April 65.0	46.9	56.0	10	2.82	0.01
May 74.7	56.9	65.8	11	3.77	trace
June 82.3	65.5	74.0	9	3.42	0.00
July 86.6	70.4	78.5	10	4.27	0.00
August 85.8	70.0	77.9	9	4.38	0.00
September 79.7	64.4	72.1	8	3.22	0.00
October 68.3	53.0	60.6	7	2.89	0.00
November 57.3	42.8	50.1	9	3.14	0.00
December 47.4	33.3	40.4	2	3.17	0.27
Annual 65.8	49.9	57.9	112	39.5	2.07
					16.31

(a) Recorded in the period 1951-1980 at Solomons, MD.
 (b) Recorded in the period 1945-1981 at Lexington Park, MD.

Sources:

Temperature:

Climatography of the United States No. 81; NOAA National Climatic Center;
 Asheville, NC, September 1982.

Precipitation:

Revised Uniform Summary of Surface Weather Observations; U.S. Air Force
 Environmental Technical Applications Center; Asheville, NC, May 1982.

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wind speed is about 6 knots. Figure 2-1 provides an average annual wind rose based on wind data from the Patuxent River Naval Air Station in Lexington Park, MD.

2.2 TOPOGRAPHY AND SURFACE DRAINAGE

The SMWT site is located within the Atlantic Coastal Plain physiographic province. Figure 2-2 provides a topographic map of the SMWT site. Topographic relief across the site is minimal, with elevations ranging between approximately 110 to 160 feet above mean sea level (MSL). The SMWT site lies on a drainage divide such that runoff from the site discharges to tributaries which straddle the site to the east and west. Both of these tributaries discharge to the Potomac River via Brooks Run and McIntosh Run. Regionally, the site is located close to the drainage divide between the Potomac and Patuxent River Basins.

2.3 SOILS

According to the soil survey maps of St. Mary's County, Maryland (Soil Conservation Service, March 1978), the site falls within the Sassafras-Beltsville soil association which covers about 5 percent of the county. This association consists of level to steeply sloped, well drained and moderately well-drained, loamy and silty soils. Some of the soils are moderately deep with hard, dense fragipans. Fragipans are an extremely dense, brittle, and compact soil layers. This soil association is found in uplands and terraces. These soils are moderately dissected by drainageways to McIntosh Run and the Patuxent River.

The Sassafras-Beltsville soil association is typically made up of about 65 percent Sassafras soils, 25 percent Beltsville soils, and 10 percent minor soils. The well-drained Sassafras soils have a surface layer of sandy loam or loam, and a well-developed subsoil of sandy dry loam. The moderately well-drained

PATUXENT RIVER MARYLAND NAS

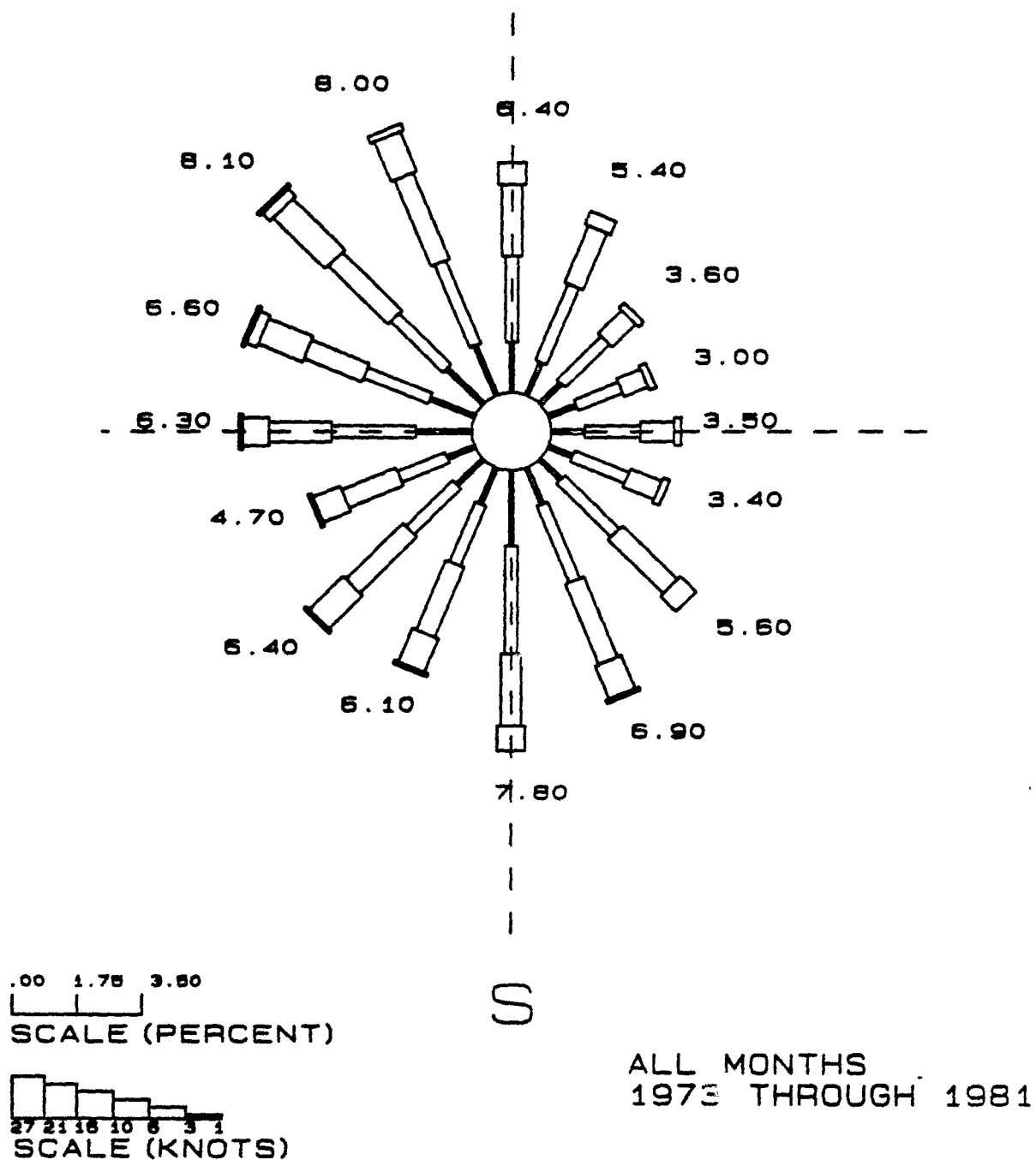


FIGURE 2-1 WIND ROSE

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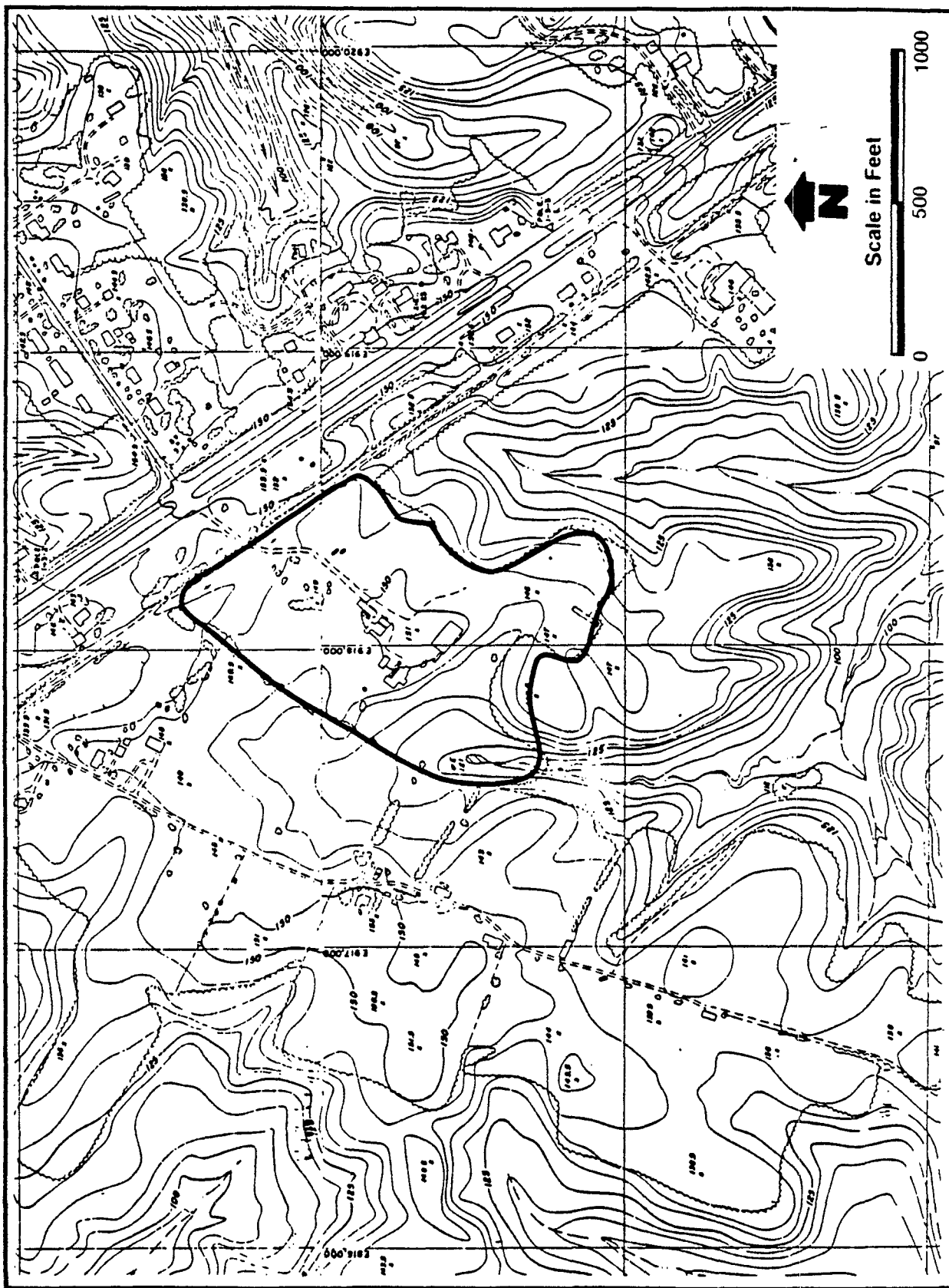


FIGURE 2-2 TOPOGRAPHIC MAP OF THE SITE

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Beltsville soils are very silty. They have a dense, hard fragipan in the lower part of the subsoil that inhibits the extension of roots and limits the downward movement of water. Seasonally, in late winter and early spring, the soil above the fragipan is saturated, but there is little or no water in or below the fragipan. Other minor soils in this association include the well-drained Chillum soils, the excessively drained Evesboro soils, and the poorly drained Bibb soils found in lower topographic areas.

Figure 2-3 depicts the major soil group types in the vicinity of the site. This map indicates that the Beltsville silt loam (B1, B2) is the principal soil type at the site. The only other soil type of any significance on-site is the Kempsville fine sandy loam (K1C2 and K1C3), a well-drained soil with properties similar to the Sassafras soils.

It is expected that a large portion of the surface and near-surface soils at the site have been disturbed and reworked by past waste disposal operations (i.e. lagoons and land treatment) and remedial activities (i.e. excavation and backfilling).

2.4 GEOLOGY

The Southern Maryland Wood Treating site lies within the Atlantic Coastal Plain physiographic province. The Atlantic Coastal sediments consist of unconsolidated gravel, sand, silt and clay deposits ranging in age from Cretaceous to Holocene. In Southern Maryland, these sedimentary beds dip to the southeast at very low angles, generally less than 1° ; forming a sedimentary wedge which increases in thickness to the southeast (Glaser, 1971). Total thickness of the unconsolidated sedimentary deposits in the area of the site is estimated to be approximately 3,500 feet (Hansen, 1972). The Coastal Plain sediments are underlain by Precambrian



FIGURE 2-3 DETAILED SOIL GROUP TYPES IN THE VICINITY OF THE SMWT SITE,

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and early Paleozoic igneous and metamorphic rocks. The generalized stratigraphy of Southern Maryland is presented in Table 2-2. Since Cretaceous sediments and the bedrock are not used as a source of ground water in the site area, the discussion of geology in this subsection is primarily focused on those sediments that range in age from Paleocene to Holocene.

Figure 2-4 shows a geologic cross-section through a portion of Southern Maryland. The major geologic units of concern include the uppermost Pleistocene sediment through the Aquia Formation. The upper portion of the Aquia Formation in the site area consists primarily of medium to coarse grained sand. The term Aquia aquifer refers to this portion of the Aquia Formation (Chapelle and Drummond, 1983). Based on well logs from locations depicted in Figure 2-4, the Aquia aquifer is estimated to be approximately 140 feet thick in the vicinity of the site. The drilling log from the inactive on-site production well (Table 2-3) indicates at least a 105-foot thick Aquia sand occurring at depths from 495 to 600 feet below ground surface. The drilling log was obtained from the Maryland Waste Management Administration.

The Marlboro Clay, a pink to silvery gray clay, overlies the Aquia Formation. This clay unit is approximately 10 feet thick at the site (see Table 2-3), and separates the Aquia Formation from the overlying Nanjemoy and Piney Point Formations.

The Nanjemoy Formation overlies the Marlboro Clay throughout Southern Maryland. In the site vicinity, the Nanjemoy Formation tends to coarsen upwards from a silty clay to a fine sand. The Nanjemoy Formation is overlain by the Piney Point Formation which is generally comprised of a medium to coarse grained sand. The Piney Point Formation and the upper portion of the Nanjemoy Formation are collectively termed the Piney Point-Nanjemoy

TABLE 2-2

GENERALIZED STRATIGRAPHY OF SOUTHERN MARYLAND (from Chapelle and Brumond, 1993)

SYSTEM	SERIES	STRATIGRAPHIC UNIT	THICKNESS (feet)	DOMINANT LITHOLOGIC CHARACTER	WATER-BEARING PROPERTIES
Quaternary and Tertiary(?)	Holocene	Lowland and	0-190	Sand, gravel, and silt (tan to rusty orange) predominantly quartz.	Yields small to moderate amounts of water to wells. Utilized primarily as a water source for shallow, domestic, and farm wells. The upper recharging water table aquifer to the Aquia and Piney Point- Manjeoy aquifers in southern Maryland.
	Pleistocene	Upland deposits			
	Pliocene(?)				
Tertiary	Miocene	Choptank Formation	0-40	Clay, silty; olive-green to gray; fossiliferous.	Functions as a confining bed.
		Calvert Formation	0-180	Clay, silty; olive-green to gray; fossiliferous; lower member is diatomaceous and contains phosphatic pebbles.	Functions as a confining bed.
		Piney Point Formation	0-80	Sand; grayish-green to grayish white medium- to coarse-grained; quartz is most common mineral; glauconitic; calcite-cemented shell beds common.	Important source of water in southern Calvert and St. Mary's Counties. Hydraulically connected to the upper sandy portion of the Manjeoy Formation.
	Eocene	Manjeoy Formation	0-250	Sand, silt, clay; blackish-green to gray; quartz most common mineral; glauconitic; the upper portion of formation is predominantly sand; the lower portion is predominantly silt and clay.	The upper sandy portion is an important source of water in Calvert and St. Mary's Counties and is hydraulically connected to the overlying Piney Point Formation. The lower portion of the formation functions as a confining bed.
		Northern Clay Formation	0-35	Clay, pinkish-red to silvery-gray; very plastic; thin lenses of pale gray silt.	Functions as a confining bed.
Paleocene	Aquia Formation		0-230	Sand, greenish-black; quartz most common mineral; glauconitic; lenses of silty clay and shell beds common; calcite cementation common.	Is a primary source of water in southern Anne Arundel County and in Calvert and St. Mary's Counties. An important source of water in southern Charles and Prince Georges Counties.
		Brightseat Formation	0-40	Silt, clayey; gray to dark gray; micaceous.	Functions as a confining bed.
	Upper Cretaceous	Severn and Naptopy Formations, indifferently	350-1700	Silt, sand, clay, interbedded.	May be a primary water source in northern Anne Arundel County, but is not present in southern Calvert or St. Mary's Counties. Severn and Naptopy functions as confining beds.
Cretaceous	Lower Cretaceous	Palapsco, Arundel and Palucent Formations, indifferently	300-2500	Silt, sand, clay, gravel interbedded.	Yields large amounts of water in Charles, Prince Georges, and northern Anne Arundel Counties. Untested in southern Calvert and St. Mary's Counties.
Paleozoic and Precambrian		Crystalline rocks (basement)	Unknown	Complex assemblage of schists, granites, gneisses, and igneous.	Untested.

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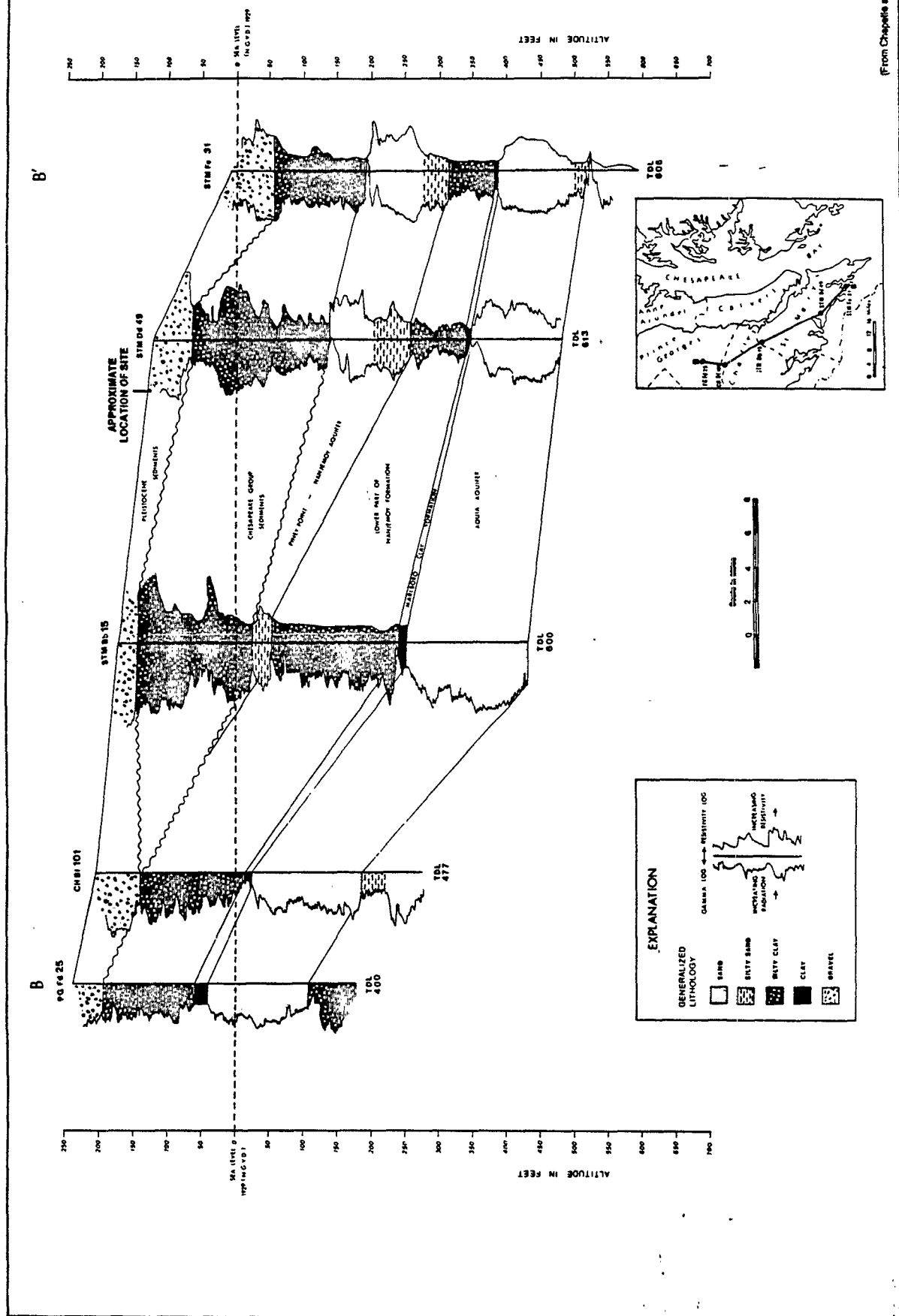


FIGURE 2-4 GEOLOGIC CROSS SECTION THROUGH SOUTHERN MARYLAND. n/a

(From *Chepelle and Drummond, 1963*)

TABLE 2-3

SUMMARY OF DRILLING LOG FOR
ON-SITE PRODUCTION WELL (INACTIVE)
SOUTHERN MARYLAND WOOD TREATING SITE

Description	Depth in Feet	Interpreted Geologic Unit
Yellow sand and clay	0-30	Pleistocene sediments
Blue clay	30-50	Chesapeake Group
Yellow sand	50-60	
Blue clay	60-90	
Green sand, shell and rock	90-135	
Green clay	135-228	
Green sand, shell and clay	228-245	Piney Point and Nanjemoy Formations
Green clay	245-285	
Green sand, shell and rock	285-325	
Black sandy clay	325-350	
Brown sand	350-370	
Black sand and clay	370-485	Marlboro Clay
White clay	485-493	
Pink clay	493-495	
Green sand	495-600	Aquia Formation

Source: State of Maryland Waste Management Administration
records.

aquifer (Chapelle and Drummond, 1983). As depicted in Figure 2-4, the Piney Point-Nanjemoy unit is approximately 230 feet thick near the site of which 130 feet is the Piney Point-Nanjemoy aquifer. Interpretation of the on-site well drilling log (Table 2-3) indicates a 200-foot thick Piney Point-Nanjemoy unit at depths from 285 to 485 feet below ground surface.

The Chesapeake Group overlies the Piney Point-Nanjemoy unit in the area of the site (Figure 2-4). In ascending order the Chesapeake group consists of the Calvert, Choptank and St. Mary's Formations. This group consists of interbedded sand, silt and clay units. At the SMTW site, the on-site well log indicates that the Chesapeake Group is approximately 255 feet thick. The uppermost strata within this group consists of a 20-foot thick blue clay. This clay is indicative of geologic strata in the St. Mary's Formation.

The Chesapeake Group at the site is overlain by Pleistocene and Holocene age Upland Deposits. These deposits are primarily composed of sand with variable amounts of gravel, silt and clay. In Southern Maryland, the Upland Deposits form a relatively thin veneer of sediments over nearly all topographic high areas, but have been eroded from the majority of drainage areas (Chapelle and Drummond, 1983).

2.5 HYDROGEOLOGY

Ground water supplies in Southern Maryland are obtained from the Coastal Plain deposits (Otton, 1955). Ground water in these sedimentary deposits occurs under both unconfined (water-table) and confined (artesian) conditions. Formations consisting of silty and clayey material act as confining layers to control vertical leakage of water between aquifers. Water bearing properties of the geologic units in Southern Maryland were

presented in Table 2-2. In the St. Mary's County area, the ground water supplies are obtained primarily from the Aquia aquifer, the Piney Point-Nanjemoy aquifer and the Upland Deposits. The most widely used aquifers for domestic and public use in Southern Maryland are the Aquia and Piney Point-Nanjemoy aquifers (Glaser, 1971).

In the area of the site, the Aquia aquifer occurs under confined conditions. The upper confining layer of the aquifer is the Marlboro clay and the silty-clayey portion of the Nanjemoy Formation. A potentiometric surface map of the Aquia aquifer in May 1980 showed ground water flow direction to be in a generally southeasterly direction in the vicinity of the site (Chapelle and Drummond, 1983).

Water level measurements presented in the well completion report detailing the construction of the on-site production well indicate a static water level of 156 feet below land surface. This well is screened from 580 to 600 feet in the Aquia aquifer. The well was reportedly pump tested at 30 gpm with a drawdown in water level of 12 feet. In the Southern Maryland area, maximum reported pumping rates for Aquia wells are approximately 300 gpm (Chapelle and Drummond, 1983).

The Piney Point-Nanjemoy aquifer is used as a source of ground water in Calvert and St. Mary's Counties. The Piney Point-Nanjemoy aquifer represents a confined aquifer, overlain by silt and clay beds of the Chesapeake Group and underlain by the lower portion of the Nanjemoy Formation and the Marlboro Clay. The drilling log for the on-site production well indicates the top of this aquifer to be approximately 285 feet below land surface. Based on May 1980 data from Chapelle and Drummond (1983), the ground water flow in this aquifer is in a northeast to south-

easterly direction in the vicinity of the site. Yields from wells screened in the Piney Point-Nanjemoy aquifer are generally less than 100 gpm (Otton, 1955).

The Upland Deposits is the uppermost water-bearing zone in the area of the site. These deposits contain the water table aquifer. The Upland Deposits are an important source of ground water supplies to rural areas in Southern Maryland. The depth of wells in the Upland Deposits are generally from less than 10 to about 50 feet. Reported water yields commonly range from 2 to 10 gpm (Otton, 1955).

A survey of available well logs in the area of the site was conducted by the REM II Team to establish ground water supply usage. Table 2-4 summarizes the supply well information. Six ground water supply wells, including the inactive on-site production well, are screened in the Aquia and Piney Point-Nanjemoy aquifers. One of these wells (C. Miedzinski) is approximately 450 yards north of the site. In addition, two residences, J. Miedzinski and Alvey, utilize shallow water table wells for their water supply. These wells are located approximately 200 yards northwest and 400 yards north of the site, respectively.

2.6 DEMOGRAPHY AND LAND USE

2.6.1 POPULATION

The population of St. Mary's County has increased from 47,388 to 59,893 from the years 1970 to 1980. The projected 1990 population is 72,750 (St. Mary's County Chamber of Commerce, 1986). As the county enjoys 400 miles of shoreline along the Potomac River, Patuxent River, and Chesapeake Bay, a substantial population increase is experienced during the summer vacation season.

TABLE 2-4

WELL INVENTORY SURVEY NEAR
SOUTHERN MARYLAND WOOD TREATING SITE

Well Owner	Location	Well Depth (ft)	Deposit or Formation
Fenwick Manor Water	Hollywood, MD	615	Aquia
Fenwick Manor Water	Hollywood, MD	622	Aquia
Town Creek Water	N. Hollywood, MD	377	Piney Point- Nanjemoy
Town Creek Water	N. Hollywood, MD	377	Piney Point- Nanjemoy
C. Miedzinski	450 yd N of SMWT	300+	Piney Point- Nanjemoy?
Southern Maryland Wood Treating (inactive)	On-site	600	Aquia
J. Miedzinski	200 yd NW of SMWT	30	Upland
Alvey	400 yd N of SMWT	"shallow"	Upland

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Section: 2
Revision: 1
Date: August 1987
Page: 16

2.6.2 EMPLOYMENT

Table 2-5 summarizes the distribution of employment in St. Mary's County. The primary agricultural product is tobacco; with corn, soybeans, wheat and other vegetables of lesser importance. The 1983 annual average unemployment rate was 7.4%.

TABLE 2-5

DISTRIBUTION OF EMPLOYMENT IN ST. MARY'S COUNTY
1983 ANNUAL AVERAGE ⁽¹⁾

	<u>Number Employed</u>	<u>Percent</u>
Federal Government	2,763	18.7
State Government	695	4.7
Local Government	1,880	12.7
Construction	1,041	7.0
Manufacturing		
Durable Goods	192	1.3
Nondurable Goods	97	0.7
Transportation, Communication & Utilities	621	4.2
Wholesale & Retail Trade		
Wholesale	733	5.0
Retail	2,506	17.0
Finance, Insurance, Real Estate	357	2.4
Farming, Poultry, Fishing ⁽²⁾	1,210	8.2
Services & Other	<u>2,677</u>	<u>18.1</u>
TOTAL	14,772	100.0

(1) Source: Maryland Department of Employment and Training,
Research and Analysis Division.

(2) Source: St. Mary's County Department of Economic and
Community Development, 1986 Data.

3.0 SITE INVESTIGATION OVERVIEW

3.1 GENERAL

This section describes the methodologies and activities performed during the field activities to date. More complete details are presented in the Project Operations Plan (Document Control No. 193-RI2-OP-CQSJ-1). The RI activities at the Southern Maryland Wood Treating site were conducted in a phased manner. In this way, the results of each phase could be used to focus the subsequent activities. Two phases have been conducted to date.

Phase I RI activities were mostly non-intrusive. The key objectives of Phase I were:

- To provide data to be used as a basis for locating Phase II sampling stations.
- Development and validation of a rapid-turnaround field screening method for PNAs.
- Focus the Phase II analytical requirements.

Table 3-1 provides a summary of the Phase I RI activities.

Phase II RI activities included sampling and analysis of tanks, soils, ground water, surface water, sediments, and air and preparation of a topographic map of the site. The overall objectives of the Phase II RI activities were:

- To define the nature, type, extent, and sources of contamination.
- To evaluate potential contaminant migration pathways.
- To provide support to the endangerment assessment and feasibility study activities.

TABLE 3-1
SUMMARY OF PHASE I RI ACTIVITIES

Task	Work Scope	Purpose	Activity Sampling Date
Develop rapid turn-around field screening method for RNAs.	<ul style="list-style-type: none"> Collect soil and water samples to use in method development. 	<ul style="list-style-type: none"> Provide basis for selecting samples for off-site analysis during Phase II RI. 	October 22, 1985
	<ul style="list-style-type: none"> Develop and validate the extraction and analytical techniques for soil and water samples. 	<ul style="list-style-type: none"> Focus sampling requirements during Phase II RI. 	
	<ul style="list-style-type: none"> Develop site survey grid. 	<ul style="list-style-type: none"> Facilitate geophysical survey work and location of sampling points. 	
Evaluate subsurface conditions.	<ul style="list-style-type: none"> Ground penetrating radar (GPR) survey. 	<ul style="list-style-type: none"> Identify possible subsurface disposal locations 	October 22-30, 1985
	<ul style="list-style-type: none"> Terrain conductivity survey. 	<ul style="list-style-type: none"> Identify possible ground water contamination 	
	<ul style="list-style-type: none"> Determine groundwater elevations. 	<ul style="list-style-type: none"> Provide basis for locating monitor wells, soil, sediment, and surface water sampling stations. 	
Define groundwater flow direction and velocity.	<ul style="list-style-type: none"> Determine surface water levels and elevations. 	<ul style="list-style-type: none"> Provide information on hydraulic characteristics of the water table aquifer. 	October 25-29, 1985
	<ul style="list-style-type: none"> Slug tests. 		
	<ul style="list-style-type: none"> Analysis of 3 soil samples for HSL organics, HSL inorganics, PCBs, 	<ul style="list-style-type: none"> Focus analytical requirements for Phase II. 	
Define analytical requirements.			October 22, 1985

AR300834

Table 3-2 provides a summary of the Phase II RI activities. The remainder of this section summarizes the site investigation activities to date.

3.2 ANALYTICAL FIELD SCREENING METHOD DEVELOPMENT

The purpose of the field screening method development and validation activities was to develop a rapid (approximately 20 minute), semi-quantitative analytical method for screening analysis of soil and water samples for polynuclear aromatic hydrocarbons (PNAs). The method was designed to provide a total concentration of PNAs which is comparable on an order of magnitude basis to those obtained using conventional analytical methods. Target detection limits for the field screening method were 1-10 ug/g for soils and 10 ug/L for waters. The field screening method was designed to be used to prioritize and select samples for conventional laboratory analysis, and to focus sampling requirements during subsequent phases of the RI. The technical approach to the development and validation of the field screening technique is described below.

The initial step in the method development included a literature review to provide information on alternative extraction and analysis methods. Based on the results of this literature review, UV fluorescence techniques for measuring PNAs were selected for method development and validation.

Naphthalene, acenaphthene, and phenanthrene were selected as target compounds based on their abundance (frequency of occurrence and concentration) in GC/MS data available from previous site investigations. Excitation and emission maxima were determined for the target compounds.

TABLE 3-2

SUMMARY OF PHASE II RI ACTIVITIES

Task	Work Scope	Purpose	Activity Sampling Date
Groundwater Investigations	<ul style="list-style-type: none"> Construction of 12 wells on-site. 	<ul style="list-style-type: none"> Define nature and extent of ground water contamination. 	<ul style="list-style-type: none"> June 16-August 19, 1986
	<ul style="list-style-type: none"> Sampling and analysis of 17 on-site and 9 residential wells. 	<ul style="list-style-type: none"> Evaluate potential for contaminant migration through ground water. 	
Air Quality Monitoring	<ul style="list-style-type: none"> Time-weighted average sampling for FNAS, VOCs, and PCP. 	<ul style="list-style-type: none"> Characterize on-site air quality. 	<ul style="list-style-type: none"> June 4-5, 1986 (mini-RAM)
	<ul style="list-style-type: none"> Real-time monitoring for VOCs with HNu and/or OVA and respirable dust with mini-RAM. 	<ul style="list-style-type: none"> Evaluate potential for contaminant transport by air. 	<ul style="list-style-type: none"> August 5, 1986 (TWA)
			<ul style="list-style-type: none"> June 16-August 19, 1986 (HNu/OVA).
Soil Investigations	<ul style="list-style-type: none"> Construction of 24 test pits, 25 soil borings (including 10 monitor wells). 	<ul style="list-style-type: none"> Characterize type and extent of soil contamination. 	<ul style="list-style-type: none"> June 16-August 19, 1986
	<ul style="list-style-type: none"> Off-site surface soil sampling (6 locations). 	<ul style="list-style-type: none"> Define local stratigraphy. 	
	<ul style="list-style-type: none"> 8 Shelby tube samples for geotechnical analysis. 	<ul style="list-style-type: none"> Evaluate geotechnical characteristics to provide data for remedial alternative analysis. 	
	<ul style="list-style-type: none"> Analysis of soil samples. 		

AR300836

TABLE 3-2 (Continued)

SUMMARY OF PHASE II RI ACTIVITIES

Task	Work Scope	Purpose	Activity Sampling Date
Tank/Retort Investigations	<ul style="list-style-type: none"> ● Sampling and analysis of tanks and retorts. 	<ul style="list-style-type: none"> ● Determine tank contents to provide data for remedial alternative analysis. 	<ul style="list-style-type: none"> ● June 16-August 19, 1986
Surface Water/Sediment Investigations	<ul style="list-style-type: none"> ● Sampling and analysis of surface waters and sediments from primary drainage vehicles from site. 	<ul style="list-style-type: none"> ● Characterize nature and extent of off-site contamination. ● Evaluate potential for contaminant migration via surface water/sediments. 	<ul style="list-style-type: none"> ● June 23-August 19, 1986
Map Preparation	<ul style="list-style-type: none"> ● Completion of topographic survey and property boundary survey and preparation of maps. ● Installation of benchmark. 	<ul style="list-style-type: none"> ● Provide support to RI data evaluatory FS, and future remedial efforts. ● Provide basis for future elevation measurements. 	<ul style="list-style-type: none"> ● April 14-23, 1987

AR300837

Suitable extraction solvent were determined for soil and water samples. Acetonitrile was selected for soil samples and hexane for water samples based on speed of dispersion, target compound sensitivity, and lack of interferences.

Once the extraction and analytical methods were determined, the effective concentration range was investigated. For soils, the effective concentration range was determined to be 0.1 to 1.0 ug/ml analyte in solution. For waters, a concentration range of 9 to 1,800 ug/L was chosen for method validation.

The method validation activities included evaluation of spiked and duplicate samples and comparison of UV screening results with GC/MS results from site soil samples. These comparisons, which are summarized in Table 3-3, demonstrate the order-of-magnitude agreement between UV fluorescence spectrophotometry and GC/MS analyses.

The method development and validation activities were successful in developing a rapid, semi-quantitative field screening method for PNAs. The method utilizes a one-step extraction technique and UV fluorescence spectrophotometry and achieves the target detection limits. Additionally, the method development and validation activities indicated that a throughput of 25 samples per day could be achieved in the field.

Additional information on the development and validation of the field screening method is provided in Appendix B.

3.3 GEOPHYSICAL STUDIES

3.3.1 GENERAL

Ground penetrating radar and terrain conductivity surveys were performed along a previously established site grid in an effort

TABLE 3-3

COMPARISON OF UV FLUORESCENCE SCREENING AND
GC/MS DATA FOR METHOD VALIDATION

Sample Number	Matrix	PNA Concentration (PPB)				GC/MS
		UV Screening			Avg	
		1	2	3		
SS-1	Soil	16.4	6.5	1.4	8.1	7.0
SS-2	Soil	21.6	45.5	60.8	42.6	120.0
SS-3	Sediment	104,000	76,300	85,700	88,500	19,600
SS-4	Soil	4.1	4.2	3.6	4.0	4.1
SW-1	Surface Water	3.1	4.4	6.3	4.6	0.7

Note: Three 1 gram aliquots from each soil sample were analyzed by the UV fluorescence screening method. A separate aliquot was analyzed by GC/MS methods.

to delineate the limits of the excavated lagoons, to potentially identify subsurface features, and to potentially define areas of ground water contamination.

An on-site survey grid was established prior to commencement of the geophysical investigations. The baseline of the grid system was referenced to the site's northeastern fence boundary. The survey grid was extended from this baseline across the site at the grid dimensions of 100 feet by 100 feet. The grid system in the area of the excavated lagoons was subdivided into 50-foot increments. Each surveyed station was staked and marked with a coordinate designation.

3.3.2 TERRAIN CONDUCTIVITY

Electromagnetic conductivity techniques using a Geonics Model EM 34-3 were performed at the established 100-ft spacing grid nodes to map variability of terrain conductivity across the site. In the area of the excavated lagoons, the EM-34 survey was conducted on a 50-foot grid pattern. Upon completion of instrument field calibration, EM conductivity was measured at a total of 107 grid stations. Measurements at the survey stations were taken in the horizontal dipole mode with a 32.8-foot (10-meter) coil separation, yielding an effective depth of exploration of 24.6 feet (7.5 meters), with a large contribution to the EM reading from near-surface materials. Vertical dipole measurements yielded an effective depth of exploration of 49.2 feet (15 meters) with a maximum contribution from materials at a depth of 13.1 feet (4 meters). Cultural interferences (buried cables, buildings, power lines, etc.) were noted at each EM location. The EM stations and corresponding measurements were plotted and contoured to define variations in conductivity that could be used to interpret changes in soil lithology and ground water chemistry. A discussion of the EM data and results is presented in Section 4.1.2.

3.3.3 GROUND PENETRATING RADAR

A ground penetrating radar survey was conducted at the site to determine, if possible, the approximate boundary locations of the old excavated lagoons. Prior to surveying, the GSSI Systems 8 radar unit was calibrated to on-site soil and moisture characteristics and theoretical depth calibrations were performed.

Subsequent to the calibration of the systems, the GPR survey was conducted by traversing the land treatment area, process area, and the excavated lagoon area with the GPR antenna on fifty-foot grid lines. The identification number of each traverse and the direction in which it was run was recorded. The product of the survey was a series of real-time subsurface profiles. A typical profile is shown in Figure 3-1. The data was standardized by affixing location marks on each profile at the grid intersection. Upon completion of the survey, the profiles were reviewed for data reduction and interpretation.

The resulting GPR profiles from this survey exhibited high resolution in defining variations in soil characteristics and subsurface features. The results of the GPR survey are presented in Section 4.1.1.

3.4 SURVEY ACTIVITIES

Topographic and property boundary surveys were performed at the site to provide support to the RI data evaluation, the FS, and future remedial efforts. A benchmark, consisting of a capped four foot length of 2 inch ID galvanized steel pipe was placed into the ground in the northwestern corner of the site to serve as a benchmark. The top of the cap was determined to be 151.22 feet above mean sea level.

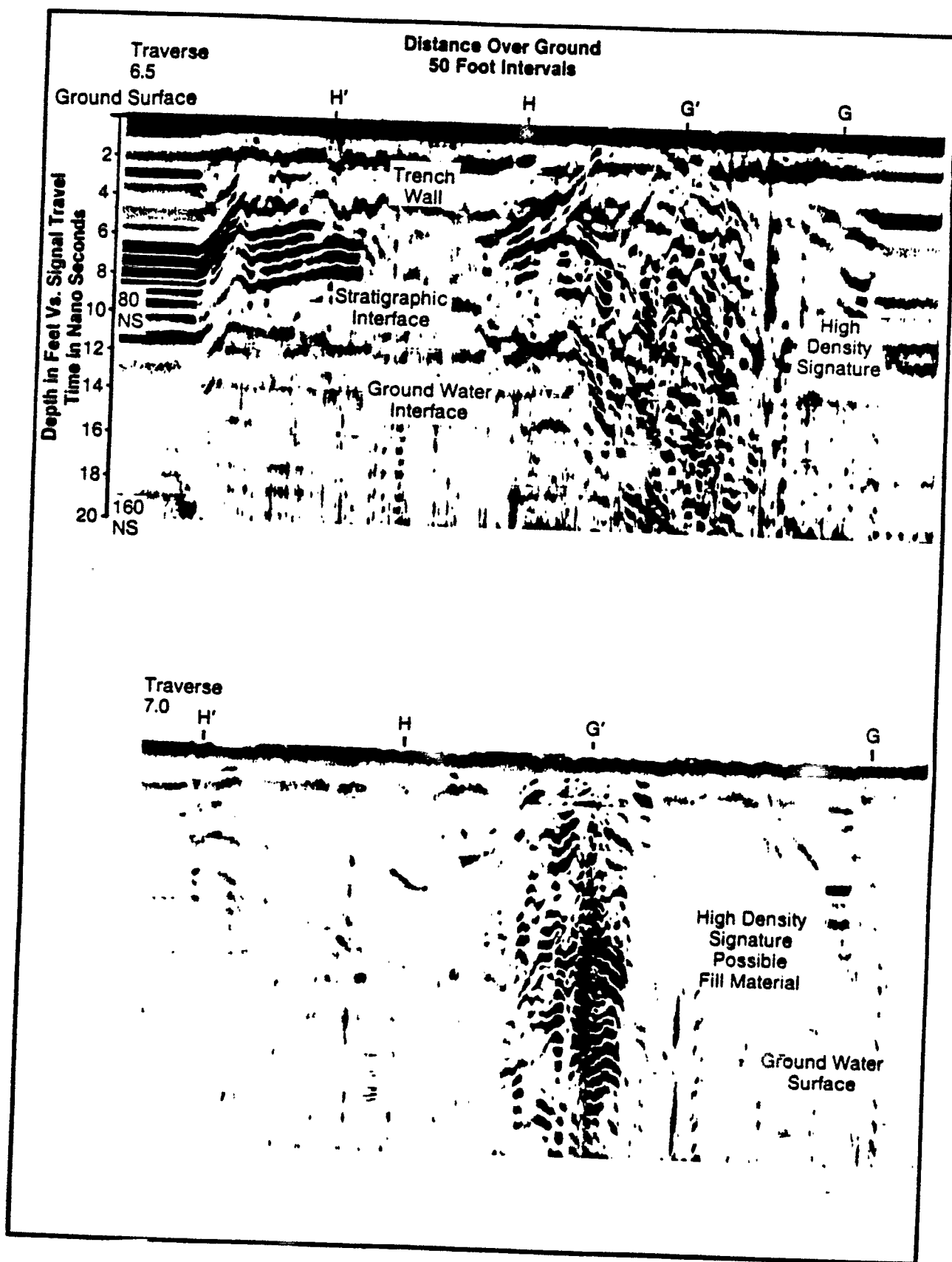


FIGURE 3-1 TYPICAL GPR PROFILE

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Phase II soil boring, monitor well, and test pit locations and elevations were determined. Aerial triangulation and digital mapping techniques were used to produce the maps.

The aerial mapping for the topographic survey was performed at a 1:660 scale followed by ground survey for horizontal and vertical controls. The topographic and planimetric features were subsequently stereo compiled to Rational Mapping Accuracy Standards utilizing Aerial photography, ground truthing and surveyed photo controls. The photo compilations were digitized on a computerized mapping system, the Data General MV4000 Geographical and Information System and Intergraph 200 Mapping System. Data manipulation and graphic design was accomplished on the Interview graphic workstation utilizing Integraph Design Software.

The completed maps are presented in Appendix C.

3.5 GROUND WATER STUDIES

3.5.1 GROUND WATER FLOW DIRECTION

As part of the Phase I RI activities, ground water flow directions in the on-site water-table aquifer were determined to provide a basis for siting Phase II RI sampling locations and to evaluate the potential for off-site transport of contaminants via ground water and surface water. Flow direction was determined from the ground water and surface water elevations measurements.

In addition, the groundwater and surface water elevations provided data to determine the hydraulic relationship between ground water and the freshwater pond and east and west tributaries.

The top of the casings of five monitor wells, four existing piezometers, and the existing production well were surveyed for elevation. Stream and pond staff gauges were established in the freshwater pond, and the east and west tributaries. As these activities were performed prior to the Phase II topographic survey (and siting of a benchmark), the elevation measurements were referenced to a benchmark assigned an elevation of 100 ft.

Two complete rounds of water level measurements were made in the monitor wells and at the stream and pond staff gauges on 25 and 29 October 1985. From the Phase I water level data, a generalized direction of ground water flow, and the identification of discharge points for the shallow water-table aquifer were established.

Phase II ground water elevation measurements were completed on April 15, 1987. Depth to water measurements were recorded for the 12 Phase II shallow wells and the five existing shallow wells. These water level measurements were related to the site benchmark installed during the topographic surveying activities. (see Section 3.4). The results of these investigations are presented in Section 4.2.1.

3.5.2 DETERMINATION OF GROUND WATER FLOW VELOCITY

In order to calibrate the hydraulic characteristics of the shallow aquifer, slug recovery tests were performed on three existing on-site monitor wells during the Phase I RI activities. The method involved the measurement of water level recovery rates after a certain volume of water is removed from the well. All water level measurements were recorded by an In-situ Model SE-200 automated data acquisition and reduction system using pressure transducers. Instantaneous lowering of the water level was

achieved by submerging a bailer in the well, letting the water level equilibrate, and then quickly removing the-bailer. Time-recovery measurements were made of the water level in the well after the bailer had been removed.

H. Bouwer and R.C. Rice (1976) developed equations for determining the hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Time-recovery data from the slug test and specific well parameter functions were used as input to a computer program designed to analyze the information using these Bouwer and Rice equations. Representation of the well parameters and the graphical analytical solutions is presented in Appendix D. A discussion of the results are presented in Section 4.2.2.

3.5.3 ON-SITE WELL CONSTRUCTION AND SAMPLING

3.5.3.1 Well Construction and Development

To more fully understand water table aquifer conditions at the site, twelve shallow monitor wells were installed during the Phase II field effort. These wells supplemented the five existing wells installed by the Maryland Waste Management Administration in 1975 (MW-01 through MW-05). The twelve monitor wells were installed by Hardin-Huber, Inc., of Baltimore, Maryland under the supervision of a REM II team geologist. Hardin-Huber worked as a subcontractor to Geomatrix, Inc., of Hyattsville, Maryland. The wells, denoted MW-06 through MW-17, are depicted on Figure 3-2. The monitor wells were screened in the Upland deposits and ranged in depth from 9 to 37 feet. Ten of the wells were screened immediately above a brown to dark gray silty clay, believed to be the St. Mary's Formation. The other two wells (MW-07 and MW-09) were installed such that the well screens were located

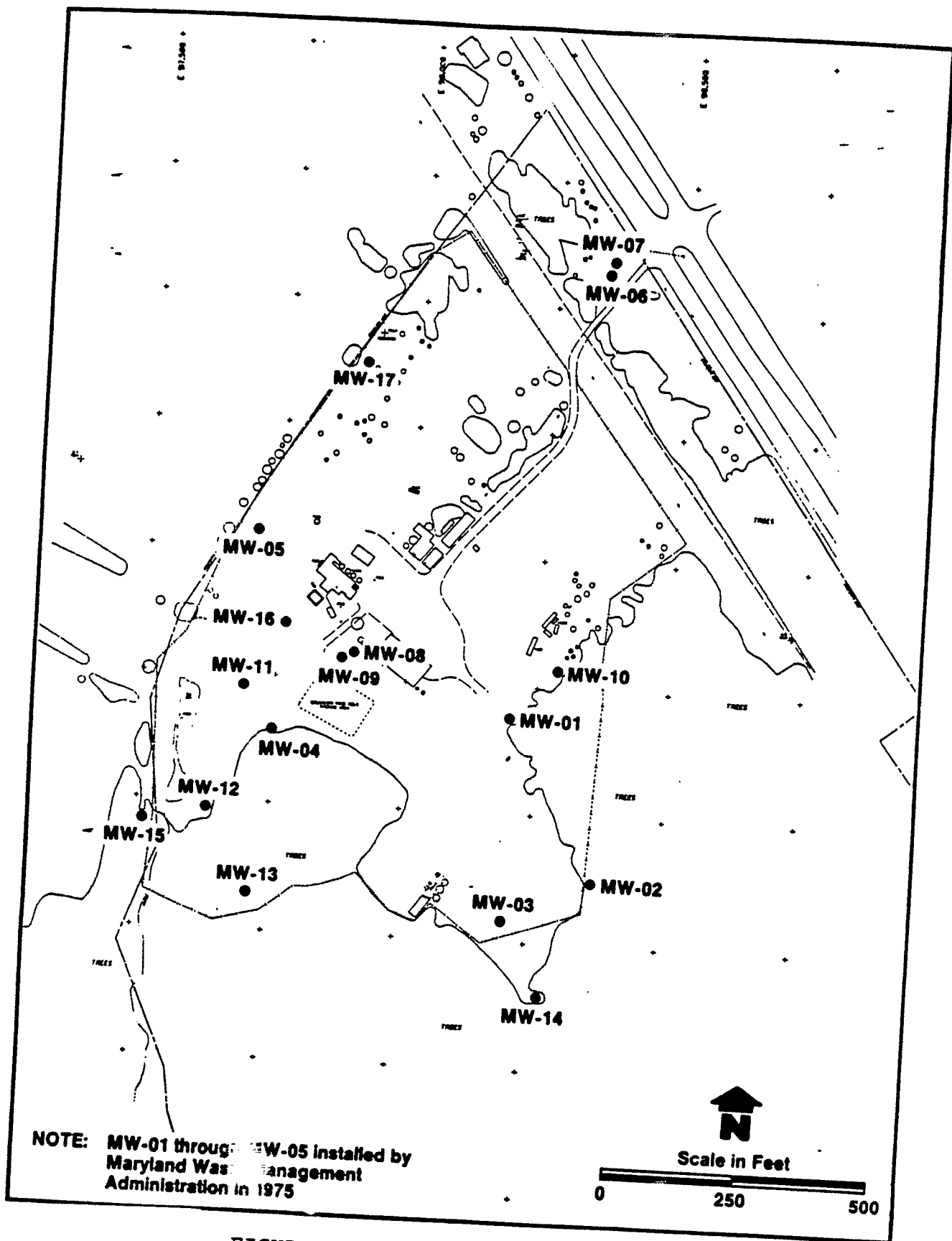


FIGURE 3-2 MONITOR WELL LOCATIONS

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approximately five feet above and below the water table. This second construction technique was utilized when the thickness of the saturated sand was greater than ten feet. The shallower well type was utilized to evaluate the presence of relatively insoluble floating hydrocarbons. Table 3-4 provides a summary of construction details and logistics for installation of each well.

Monitor well construction was accomplished by hollow-stem auger drilling techniques. Split-spoon sampling was performed during the drilling process. The materials used for well construction consisted of 4" ID Schedule 40 PVC riser pipe and 0.010" slot continuously wound screens. The annular space around the screen was filled with a filter pack of coarse grained, uniform sand to prevent clogging of the well screen. Above the sand pack, a bentonite seal was placed, usually two to three feet in thickness. The remainder of the annular space was filled with a cement-bentonite grout slurry. A protective steel casing with a lockable cap was installed over each well stickup.

Well development was performed using a submersible pump and/or bailers. Development was continued until well water become noticeably less silty as determined by the on-site geologist. During well development, water level measurements were taken intermittently. Appendix E contains boring logs, well construction diagrams, and well development logs for each of the monitor wells.

3.5.3.2 Monitor Well Sampling and Analysis

Monitor well sampling was performed using 2" ID stainless steel or PVC bailers. Prior to sampling, the water level was measured with a water level indicator. The depth to the bottom of the well was also determined. The height of the water column and

TABLE 3-4

SUMMARY OF WELL CONSTRUCTION

Monitor Well No.	State Tag No.	Boring Depth (ft)		Screened Interval (ft)		Purpose of Well
		Below Ground Surface	Above Mean Sea Level	Below Ground Surface	Above Mean Sea Level	
MW-06	SM-81-1295	37.0	107.9	25.0-30.0	114.9-119.9	● Background location.
MW-07	SM-81-1294	24.5	120.5	14.0-24.0	121.0-131.0	● Screened for floating compounds. ● Background location.
MW-08	SM-81-1292	30.5	116.0	24.0-29.0	117.5-122.5	● Ground water quality in process area. ● Define ground water divide.
MW-09	SM-81-1293	29.0	114.6	13.0-23.0	120.6-130.6	● Ground water quality in process area. ● Screened for floating compounds.
MW-10	SM-81-1291	30.0	118.1	18.0-28.0	120.1-130.1	● Ground water quality near abandoned tanks.
MW-11	SM-81-1290	12.0	119.0	12.0	119.0-127.0	● Ground water quality in area of excavated lagoons. ● Define ground water divide.

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TABLE 3-4

SUMMARY OF WELL CONSTRUCTION (Continued)

Monitor Well No.	State Tag No.	<u>Boring Depth (ft)</u>		<u>Screened Interval (ft)</u>		<u>Purpose of Well</u>
		<u>Below Ground Surface</u>	<u>Above Mean Sea Level</u>	<u>Below Ground Surface</u>	<u>Above Mean Sea Level</u>	
MW-12	SM-81-1288	12.0	116.0	4.0-11.5	116.5-124	<ul style="list-style-type: none"> ● Ground water quality near freshwater. ● Characterize ground water relationship between spray irrigation area and pond.
MW-13	SM-81-1289	31.5	114.1	18.5-28.5	117.1-127.1	<ul style="list-style-type: none"> ● Ground water quality in spray irrigation area. ● Define local flow direction.
MW-14	SM-81-1254	13.5	117.5	5.5-10.5	120.5-125.5	<ul style="list-style-type: none"> ● Ground water quality downgradient from land treatment area.
MW-15	SM-81-1255	12.0	118.0	4.0-9.0	121.0-126.0	<ul style="list-style-type: none"> ● Ground water quality downgradient of freshwater pond.
MW-16	SM-81-1256	21.5	114.2	9.5-19.5	116.2-126.2	<ul style="list-style-type: none"> ● Ground water quality downgradient of process area. ● Define ground water divide.
MW-17	SM-81-1253	40.0	111.4	22.0-37.0	114.4-129.4	<ul style="list-style-type: none"> ● Ground water quality in northern part of site.

AR300849

volume of water in the well were calculated and recorded. The wells were bailed of three to five times the volume of water in the well prior to sample collection.

Ground water samples were collected from monitor wells MW-01 through MW-17 and analyzed for benzene, toluene, xylenes (BTX), and HSL semi-volatiles at a subcontractor laboratory (Century Laboratories, Inc. of Thorofare, NJ). Analyses were performed using EPA Contract Laboratory Program (CLP) methods. Samples were not filtered prior to analyses. Samples from all wells were analyzed on-site for temperature, pH, specific conductivity and PNAs (using the field screening method). Samples from monitor wells MW09 and MW11 were also analyzed for congener specific and 2,3,7,8-substituted dioxins and furans at a CLP laboratory.

Results of the ground water analysis are discussed in Section 4.2.3.

3.5.4 RESIDENTIAL WELL SAMPLING

Nine residential wells located within one-half mile of the site were sampled during the Phase II RI. Figure 3-3 depicts the approximate locations of these residential wells. Table 3-5 provides the names of the residents. Samples were collected as close to the source as practical and before the water entered any water treatment systems. The water system was purged prior to sampling.

Samples were analyzed for BTX and HSL semi-volatile organics. Analyses were performed by Century Laboratories, Inc. following CLP protocols. On-site analysis consisted of field screening for PNAs, and field pH, specific conductivity, and temperature measurements.

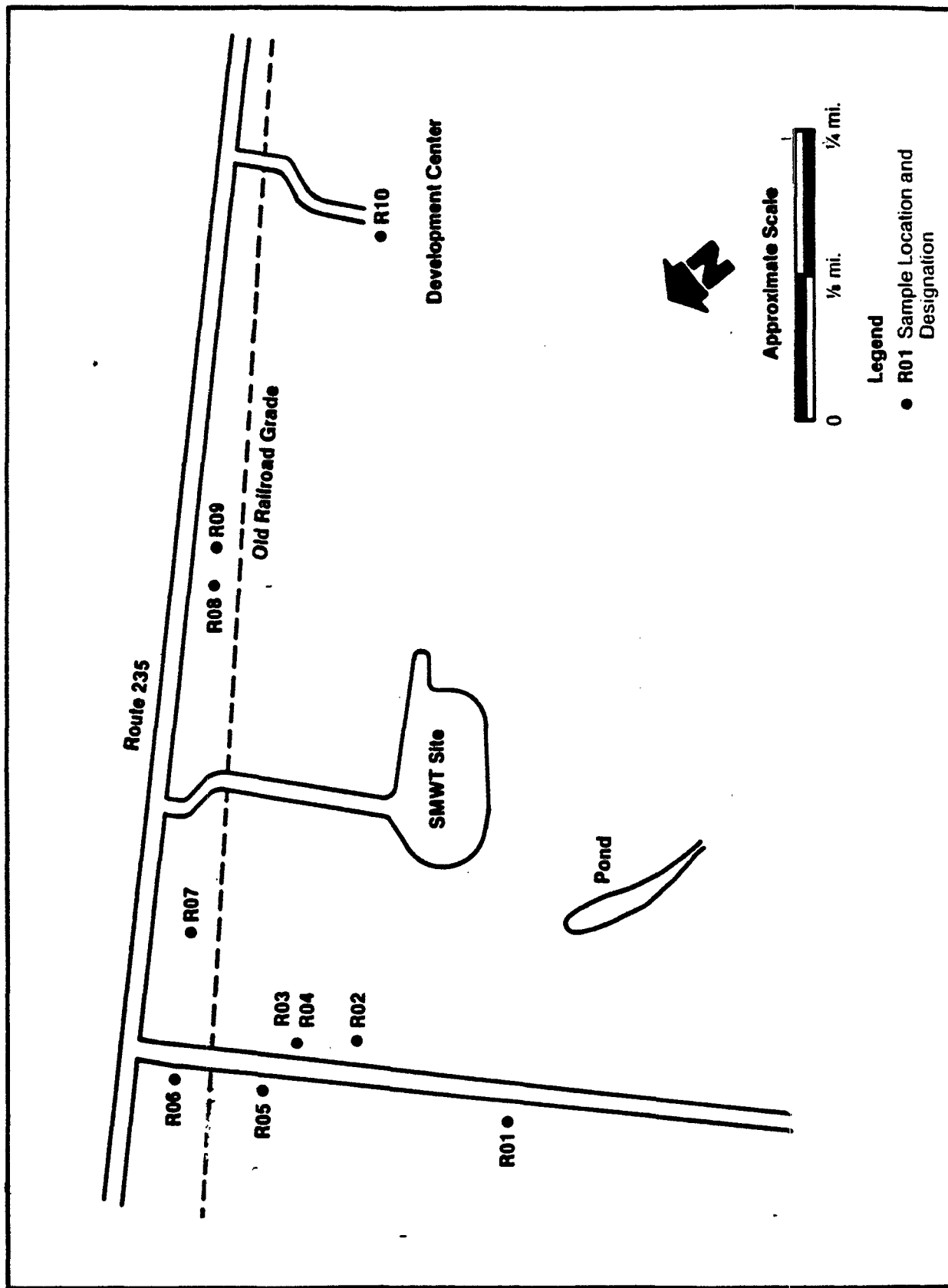


FIGURE 3-3 LOCATIONS OF RESIDENTIAL WELLS SAMPLED DURING RI PHASE II

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TABLE 3-5

SUMMARY OF RESIDENTIAL WELLS SAMPLED

<u>Location No.</u>	<u>Resident</u>
R01	J. Miedzinski
R02	C. Miedzinski
R03/R04	Alvey
R05	Cusic
R06	Herndon
R07	Huntt
R08	Van Wert
R09	Owens
R10	St. Mary's County Development Center

Results of the residential well sampling and analysis are presented in Section 4.2.3.1.

3.6 AMBIENT AIR QUALITY

Air quality was monitored during the Phase II RI on both a real-time and time-weighted average (TWA) basis at the SMWT site.

Real-time air monitoring was performed primarily for health and safety purposes. Real-time air monitoring consisted of monitoring for volatile organic compounds (VOCs) during intrusive activities using a photoionization detector (HNU) and/or a flame ionization detector (OVA). VOC monitoring was performed throughout the course of the Phase II RI. Respirable particulate concentrations were monitored on June 4 and 5, 1986 with a miniature real-time air monitor (mini-RAM).

Time-weighted average (TWA) sampling for VOCs, PNAs, and pentachlorophenol was conducted on August 5, 1986. NIOSH approved methods were used. The TWA sampling locations are depicted on Figure 3-4. The sampling methods used were:

NIOSH 5515	PNAs
NIOSH S297	Pentachlorophenol
NIOSH P&CAM 127	Volatile Organic Compounds

Results of the air quality investigations are discussed in Section 4.3.

3.7 SOIL INVESTIGATION

3.7.1 GENERAL

Soil sampling and analysis was performed during both RI phases at the SMWT site. Phase I sampling and analysis consisted of the

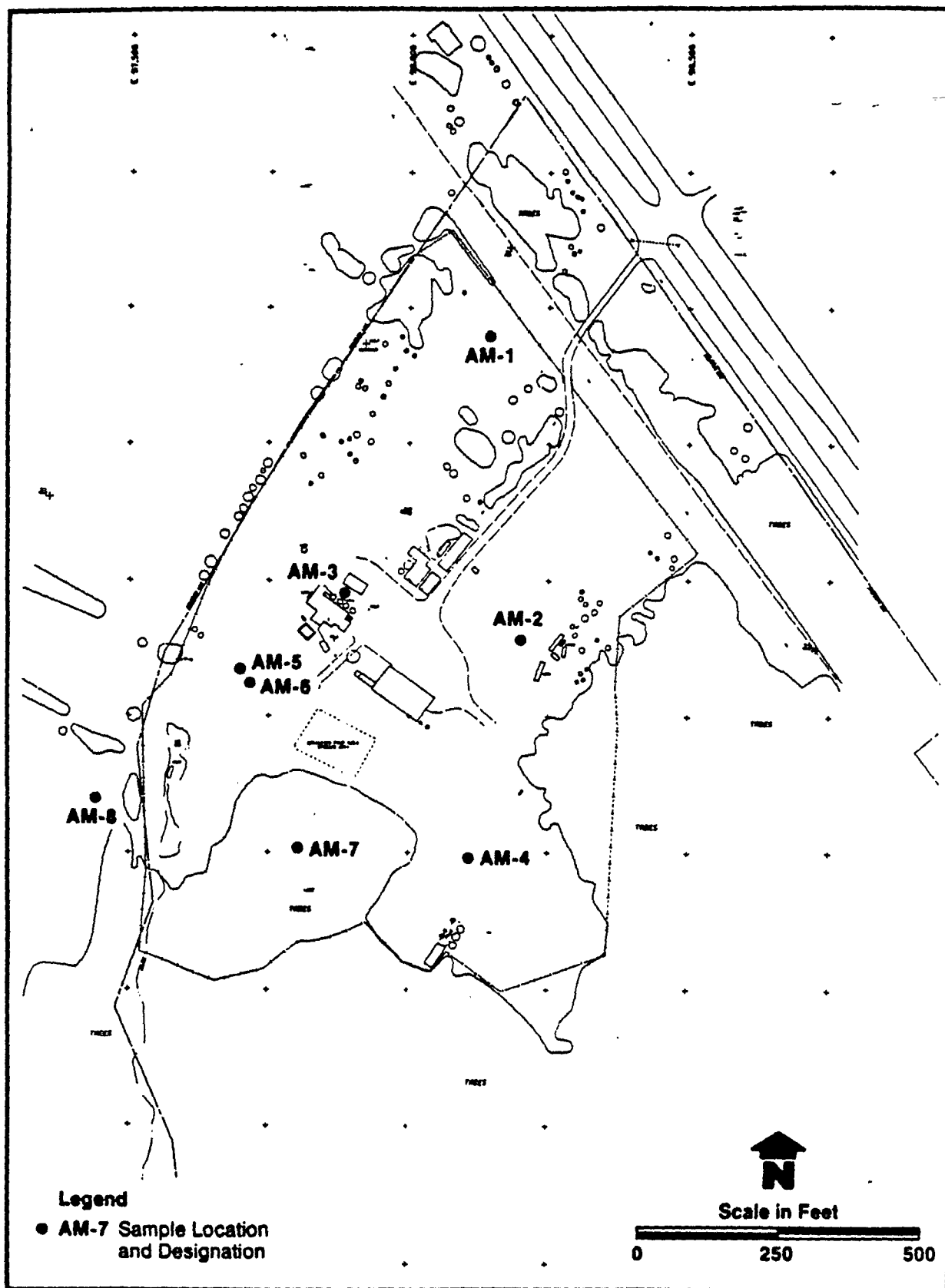


FIGURE 3-4 LOCATIONS OF SAMPLING STATIONS FOR TIME-WEIGHTED
 AVERAGE AIR SAMPLING

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collection of three surface soil samples which were used to develop the field screening method. Surface soil samples from two Phase I locations were analyzed for HSL organics, PCBs, pesticides, HSL inorganics and cyanide to focus the analytical requirements at subsequent phases. These two samples were collected from areas that would be expected to be contaminated (the process area and the excavated lagoon area) based on previous sampling data. The third sample was used as a background sample for the field screening method development. The Phase I soil sampling locations are depicted in Figure 3-5.

Phase II soil sampling included soil borings, test pits, Shelby tube sampling, and surface soil sampling. The objectives of the Phase II soil investigations were described in Table 3-2. Figure 3-6 depicts the Phase II soil sampling locations. All Phase II soil samples were analyzed for PNAs using the field screening method. Selected samples were analyzed at off-site laboratories for more comprehensive chemical and geotechnical parameters as described in Subsections 3.7.3 and 3.7.4. The soil boring and test pit logs from Phase II soil samples are included in Appendix E. Table 3-6 summarizes the Phase II soil sampling and analysis program, and the results of the soil investigations are discussed in Section 4.4.

3.7.2 SOIL SAMPLING

3.7.2.1 Soil Boring Sampling

A total of 25 soil borings were constructed during the Phase II RI activities. Of these 25 soil borings, 12 were converted to monitor wells. In addition to the 25 soil borings constructed during the Phase II RI activities, three additional borings were completed in January 1986 during the Immediate Removal Action

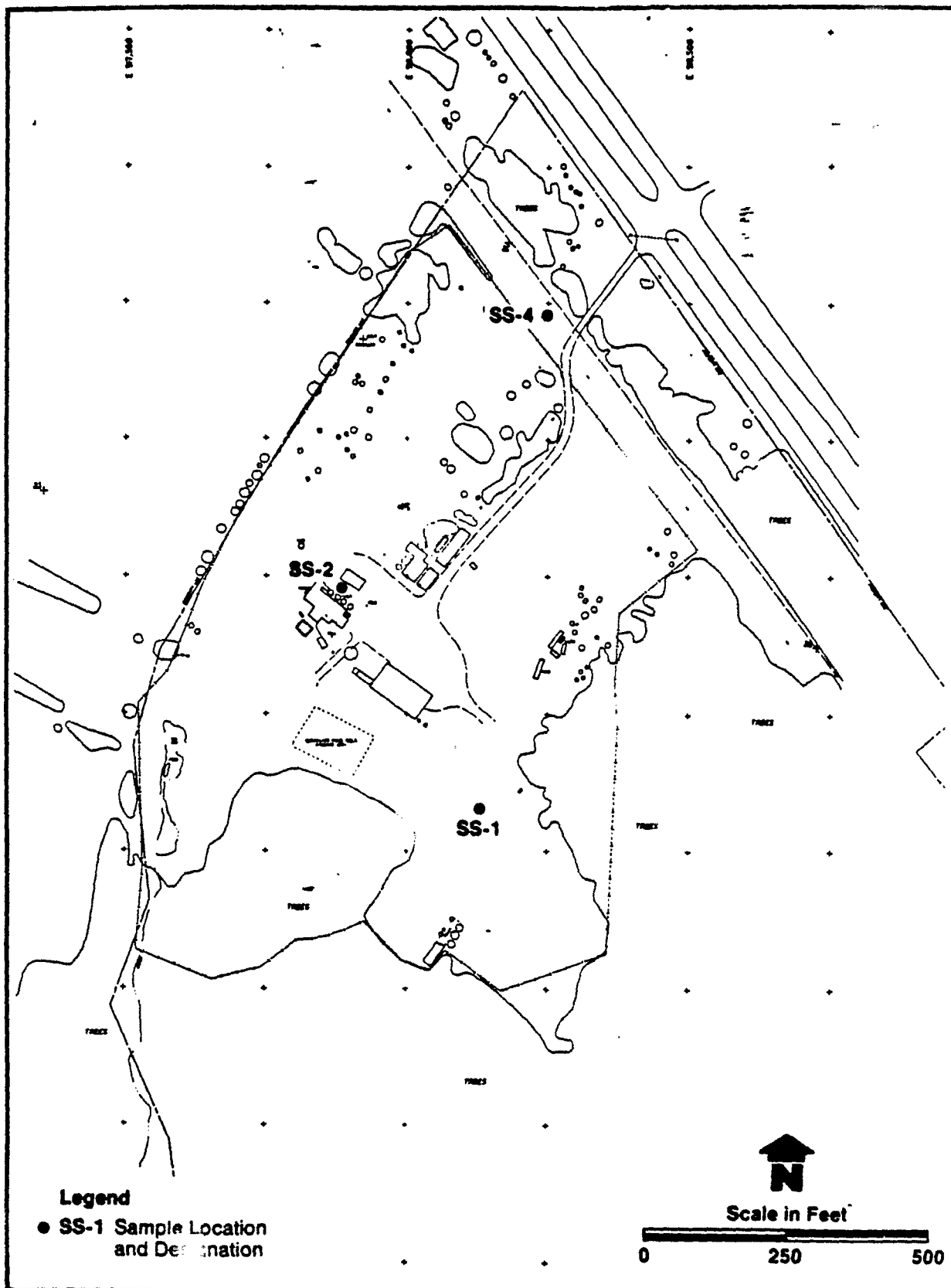


FIGURE 3-5 PHASE I SOIL SAMPLING LOCATIONS

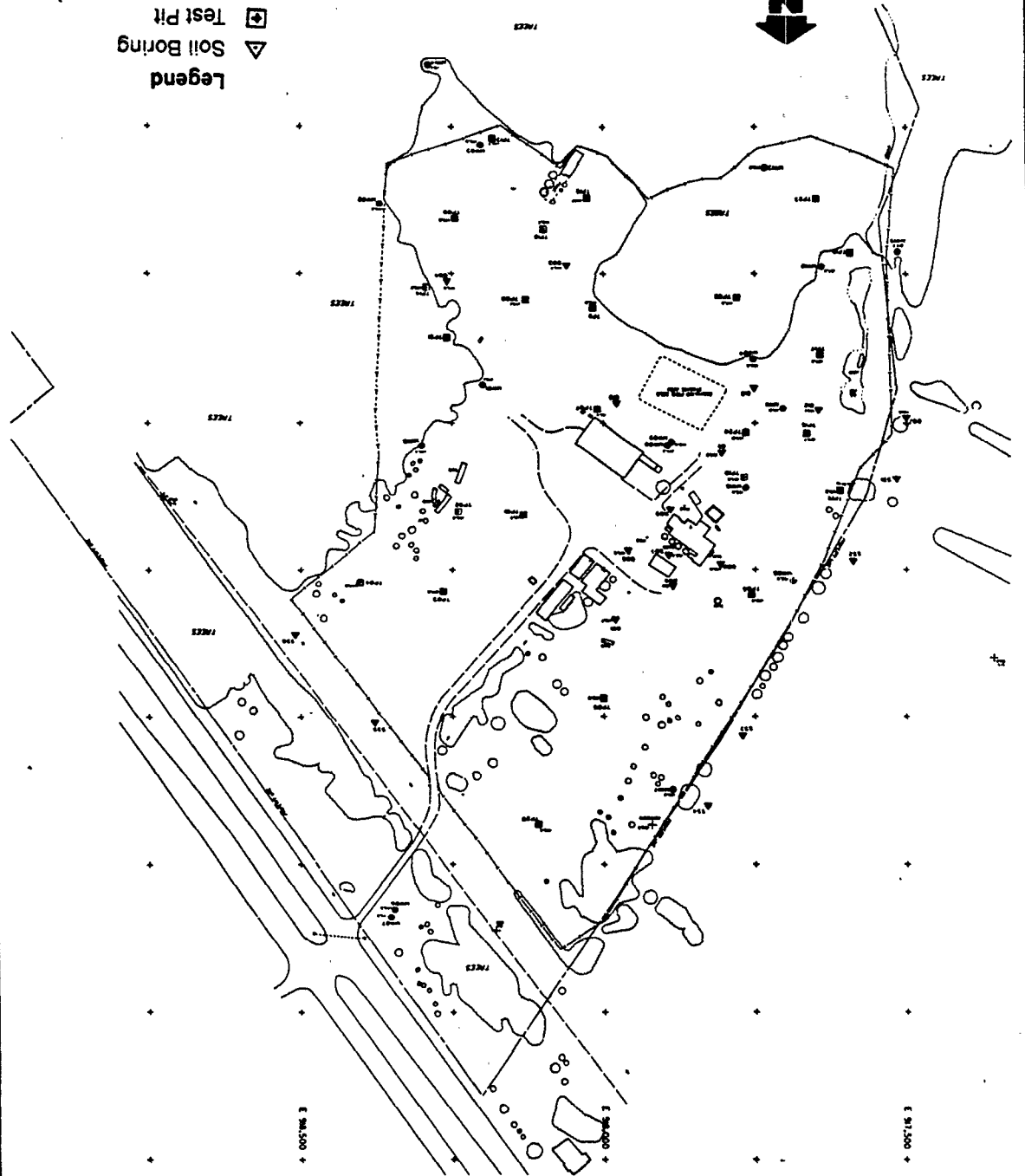
AR300856

NOTE: MW-01 through MW-05 installed by
Maryland Waste Management
Administration in 1975

Scale in Feet
0 250 500



Legend
△ Soil Boring
⊕ Test Pit
⊗ Monitor Well Boring



AR300857

TABLE 3-6

SUMMARY OF RI PHASE II SOIL SAMPLES

ANALYSIS										
Sampling Method	No. of Locations	No. of Samples	Screening for PNAs	HSL VOCs	HSL semi-volatiles	TOC & Oil & Grease	Selected Metals ¹	Geotech Parameters ²	Dioxins	
Soil borings	16 ⁽³⁾	198	198	19	19	14	19	34	9	
Soil borings for monitor wells	12 ⁽⁴⁾	84	84	4	4	2	4	3	0	
Test pits	24	182	182	43	42	2	42	0	0	
Surface soil samples	7	22	22	8	8	0	8	0	5	
Total	59	486	486	74	73	18	73	37	14	

(1) Chromium, Lead, Zinc, Copper, Mercury, Iron, Aluminum.

(2) See Section 3.6.4 for specific parameters

(3) Three soil borings were completed in January 1986 by the US EPA Region III Technical Assistance Team for the REM II team prior to constructing an enclosed stockpile.

(4) Only ten locations were sampled during monitor well construction, the other two were installed immediately adjacent to other, deeper wells.

AR3000858

prior to constructing a lined, enclosed stockpile for materials excavated from the freshwater pond. The soil samples from these borings were analyzed for total PNAs using the UV fluorescence screening method.

Soil borings were advanced using hollow-stem auger drilling. Samples were collected with a standard split spoon barrel sampler using Standard Penetration Testing in accordance with ASTM D1586. Soil samples were described using the Unified Soil Classification System.

For the 16 soil borings, samples were collected on a continuous basis in two-foot intervals. Upon completion, soil borings were grouted with cement-bentonite slurry. During construction of ten of the monitor wells, split spoon samples were taken at five-foot intervals. The sampling interval was changed to two and one-half foot intervals in the capillary fringe zone (the zone above the water table). Continuous sampling was used near the suspected location of the top of the clay layer. The decision to change sampling intervals was made by the REM II geologist based on visual observations of soils encountered and the results of the Phase II water level measurements. Soils from the remaining two wells, which were located adjacent to wells previously installed during Phase II, were not sampled during drilling.

3.7.2.2 Surface Soil Samples

Surface soil samples were collected at four locations during Phase I and at seven locations during Phase II. The Phase I samples and one Phase II surface soil samples taken from the stained area near Tank No. 10 were collected with a stainless steel trowel. The remaining Phase II surface soil samples were collected from a 0 to 18 inch depth using a standard split spoon

barrel sampler in accordance with Standard Penetration Testing Method ASTM D1586. These samples were then split into the 0-6, 6-12 and 12-18 inch intervals for analytical purposes. The surface soil borings were backfilled with cuttings and marked with survey stakes for future identification.

3.7.2.3 Test Pit Samples

Twenty-four test pits were constructed during Phase II. The locations of the test pits are shown in Figure 3-6. A backhoe was utilized to construct the test pits. Typical test pit dimensions were 15 feet long by 5 feet wide. Each pit was excavated to a depth of 15 feet or until ground water was encountered, whichever came first.

Test pit excavation was started by removing approximately four feet of soil and placing it on a plastic ground cover. The sides of the pit were inspected by a geologist. Soil descriptions and classifications were recorded using the Unified Soil Classification System. Any visible staining or contamination was also recorded. Soil samples were taken by carefully removing representative soil from the side of the pit. Descriptive samples were collected for each soil type encountered. As test pit excavation continued below a depth of four feet, samples were collected from the backhoe bucket. This measure was taken for safety purposes, so that personnel did not enter the test pit.

Upon completion of the excavation, the pit was backfilled with the excavated soils in the order in which they were removed. The backfill was tamped down in one foot lifts with the backhoe shovel to reduce any subsequent settlement. The test pits were then staked and labelled for future identification.

3.7.3 CHEMICAL ANALYSES OF SOIL SAMPLES

3.7.3.1 Phase I Soil Samples

Three surface soil samples were collected during the Phase I RI field effort. Two of these samples were collected from areas at the site which were identified as contaminated from previous sampling and analytical programs. The third sample, from an off-site location, was selected as a background sample.

As described in Section 3.7.1, the two samples which were assumed to be contaminated were analyzed for the HSL volatile organic compounds, PCBs, pesticides, inorganic parameters and cyanide through the U.S. EPA Contract Laboratory Program. The purpose of this broad spectrum analytical program was to focus the analytical requirements of future RI phases by eliminating parameters that were not detected in the Phase I samples.

The Phase I surface soil samples from the three Phase I locations were also analyzed for HSL semi-volatile organics at the Roy F. Weston, Inc. laboratory in Lionville, PA, as part of the development of the PNA screening method described in Section 3.2.

The results of these analyses are discussed in Section 4.4.

3.7.3.2 Phase II Soil Samples

The analytical program for soil samples collected during Phase II was detailed in Table 3-6. The major objective of this program was to define the nature and extent of soil contamination to support a risk assessment and feasibility study.

All soil samples which were collected during Phase II were analyzed for PNAs using the field screening method. Surface soil

borings were separated into 0-6", 6-12", and 12-18" subsamples prior to analysis. Shelby tube samples were not analyzed for chemical parameters.

Samples were selected for more comprehensive chemical analysis based upon several criteria including:

- Visual observations of soil type.
- Visual observations of staining.
- Results of organic vapor measurements during sampling.
- Results of field screening for PNAs.
- Results of prior investigations.
- Site history.

Chemical analyses were performed by Century Laboratories, Inc. and included:

- HSL volatile organic compounds.
- HSL semi-volatile organic compounds.
- Total organic carbon (TOC).
- Oil and grease.
- Aluminum, Chromium, Copper, Iron, Lead, Mercury, and Zinc.

Congener specific and 2,3,7,8-substituted dioxin and furan analysis was performed through the CLP system.

The results of the analyses are discussed in Section 4.4.

3.7.4 GEOTECHNICAL ANALYSES OF SOIL SAMPLES

A total of 37 samples from 13 soil borings were analyzed for geotechnical parameters. These samples included eight Shelby tube samples which were collected from four soil borings (BO2,

AR300862

B04, B11, B12). The geotechnical analyses were selected to provide support to the technical evaluation of remedial technologies. Geotechnical analysis was subcontracted to Engineers International, Inc. of Westmont, IL through a competitive bid process.

The geotechnical analytical program is summarized in Table 3-7. The specific analyses performed and major objectives of each test are described below.

Grain Size Analysis (ASTM D-422) - Eight samples from four soil borings were analyzed for grain size classification. The major objective of this test was to relate field descriptions to actual grain size distribution as support to permeability, stability, and treatability evaluations of various soil types. Grain size will impact ground water recovery rates and the maintenance requirements for recovery and treatment systems.

Atterberg Limits Determination (ASTM D-4318) - Five samples from three soil borings were analyzed for Atterberg limits. Atterberg limits describe the consistency of clays and other cohesive soils at various moisture contents. These test results are useful in evaluating the stability and ease of dewatering of soils.

Shear Strength (ASTM D-2573) - Three samples from three soil borings were analyzed for shear strength. Shear strength provides a measure of soil stability and is used in evaluating constructability of for trenches, slurry walls, and other excavations.

Triaxial Permeability (ASTM D-2850) - Five samples from three soil borings were analyzed for triaxial permeability. Triaxial permeability provides a measure of the rate of movement of water

TABLE 3-7

SUMMARY OF GEOTECHNICAL ANALYTICAL PROGRAM

SAMPLE NUMBER	DEPTH INTERVAL (FEET)	GRAIN SIZE	ATTERBERG LIMITS	SHEAR STRENGTH	TRIAXIAL PERMEABILITY	MOISTURE CONTENT	SPECIFIC GRAVITY
SO-B02-003	4.0-6.0					X	
SO-B02-006/007	10.0-14.0	X	X		X	X	
SO-B02-007	12.0-14.0					X	
SO-B02-008	14.0-16.0			X		X	
SO-B02-009	16.0-18.0	X				X	X
SO-B03-005	8.0-10.0					X	
SO-B03-010	18.0-20.0					X	
SO-B04-004	6.0-8.0					X	
SO-B04-011/013	20.0-26.0	X	X		X	X	
SO-B04-015	28.0-30.0	X	X		X	X	
SO-B05-006	10.0-12.0					X	
SO-B06-007	12.0-14.0					X	
SO-B06-014	26.0-28.0					X	
SO-B07-009	16.0-18.0					X	
SO-B07-014	26.0-28.0					X	
SO-B07-019	36.0-38.0					X	
SO-B08-005	8.0-10.0					X	
SO-B08-012	22.0-24.0					X	
SO-B09-008	14.0-16.0					X	
SO-B09-013	24.0-26.0					X	
SO-B10-004	6.0-8.0					X	
SO-B10-011	20.0-22.0					X	
SO-B11-002	2.0-4.0					X	
SO-B11-005	8.0-10.0					X	
SO-B11-006/009	10.0-18.0	X				X	
SO-B11-011	20.0-22.0			X		X	
SO-B11-012	22.0-24.0	X				X	X
SO-B12-002	2.0-4.0					X	
SO-B12-004	6.0-8.0	X	X	X	X	X	X
SO-B12-006	10.0-12.0					X	
SO-B12-007	12.0-14.0		X		X	X	
SO-B12-008	14.0-16.0	X			X	X	
SO-B13-002	2.0-4.0					X	
SO-B13-004	6.0-8.0					X	
SO-MW17-002	4.5-6.5					X	
SO-MW17-008	29.5-31.5					X	
SO-MW17-010	38.0-40.0					X	

AR300864

through soil and is useful in evaluating ground water interception, containment, and recovery options, and to characterize the permeability of the clay layer under the site.

Moisture Content (ASTM D-2216) - Thirty-seven samples from 13 soil borings were analyzed for moisture content. Moisture content impacts the cost of many remedial options (i.e., incineration, ground water treatment). Moisture content is also related to the void ratio of soils, therefore impacting soil permeability and compactability.

Specific Gravity (ASTM D-854) - Three samples from three soil borings were analyzed for specific gravity. The specific gravity of a soil provides an evaluation of mass per unit volume of soil. Specific gravity can be used to size treatment systems based on volume estimates of soil to be treated.

3.8 BUILDINGS, TANKS, AND RETORTS

During the Phase II field activities, the on-site process building was investigated during a walk-through inspection. The focus of the inspection was to inventory tanks, drums, or other obvious waste sources within the process building.

An effort was made to sample all 14 tanks and the two retorts. Tanks were sampled through vents, portholes, or other openings using bailers, stainless steel trowels, or PVC bottles as necessary. Samples were collected from ten tanks. Tank samples were analyzed at Century Laboratories, Inc. for HSL volatile and semi-volatile organics and selected metals. Selected tank samples were analyzed for congener specific and 2,3,7,8-substituted dioxins and furans. Tanks were measured and the volume of contents determined. Figure 3-7 depicts the locations of the major buildings and tanks on-site.

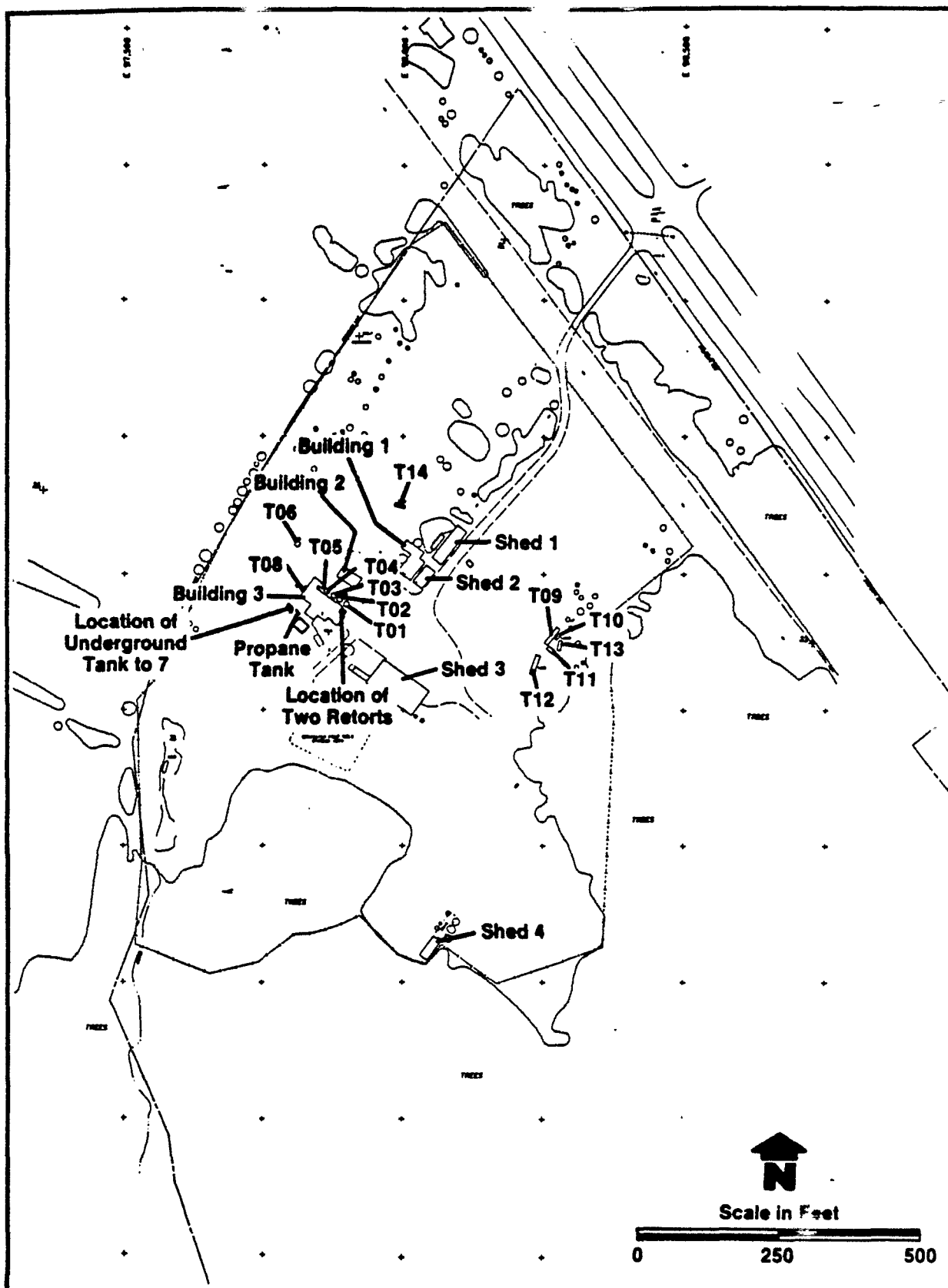


FIGURE 3-7 LOCATIONS OF TANKS, BUILDINGS AND RETORTS

AR300866

Results of the building, tank and retort investigations are presented in Section 4.5.

3.9 SURFACE WATER AND SEDIMENT STUDIES

3.9.1 GENERAL

Previous investigations performed at the SMWT site concluded that surface water and sediments leaving the freshwater pond through the west tributary were a significant pathway for off-site migration of contaminants. The surface water and sediment investigations conducted during the RI were designed to meet the following objectives:

- Define the nature and extent of contamination in the freshwater pond and west tributary.
- Determine whether the east tributary is a pathway for migration of contaminants from the site.
- Provide information to support a risk assessment.
- Provide data to evaluate general surface water quality and treatability options.
- Define the hydrologic relationship between on-site ground water and local surface water.

3.9.2 SUMMARY OF SAMPLING AND ANALYSIS ACTIVITIES

3.9.2.1 Phase I Investigations

Phase I surface water and sediment studies were designed to support development of the field screening method and to define the hydrologic relationship between on-site ground water and local surface water.

A surface water and a sediment sample were collected from the freshwater pond for development of the field screening method (Sec. 3.2). The surface water sample was analyzed for HSL semi-volatiles and the sediment sample was analyzed for HSL volatiles, HSL semi-volatiles, HSL pesticides, PCBs, inorganics and cyanide to focus the Phase II analytical program. Figure 3-8 depicts the Phase I surface water/sediment sampling location.

As described previously in Section 3.4.1, staff gauges were established in the freshwater pond, and the east and west tributaries. Surface water elevations were measured and related to ground water elevations. The purpose of this comparison was to determine the hydrologic relationship between the shallow water table aquifer and surface water.

3.9.2.2 Phase II Investigations

Phase II surface water/sediment studies included a comprehensive sampling of local ponds and tributaries that receive drainage from the site. Figure 3-9 depicts the Phase II surface water/sediment sampling locations. A total of 32 surface water and 65 sediment samples were collected from 44 stations. Sediment samples were collected at 0-6" and 6-12" depth intervals. The sampling geologist determined at what stations 6-12" sediment samples would be collected. These determinations were primarily based upon observations of sediment type and depth, the presence of any staining, and water flow volumes.

Surface water samples were tested in the field for temperature, pH, and specific conductivity. Additional surface water samples were collected for dissolved oxygen analysis and for field screening for PNAs. Sediment samples were also collected for PNA field screening analysis. Visual observations of water flow, sediment appearance, and any stains or sheens were recorded.

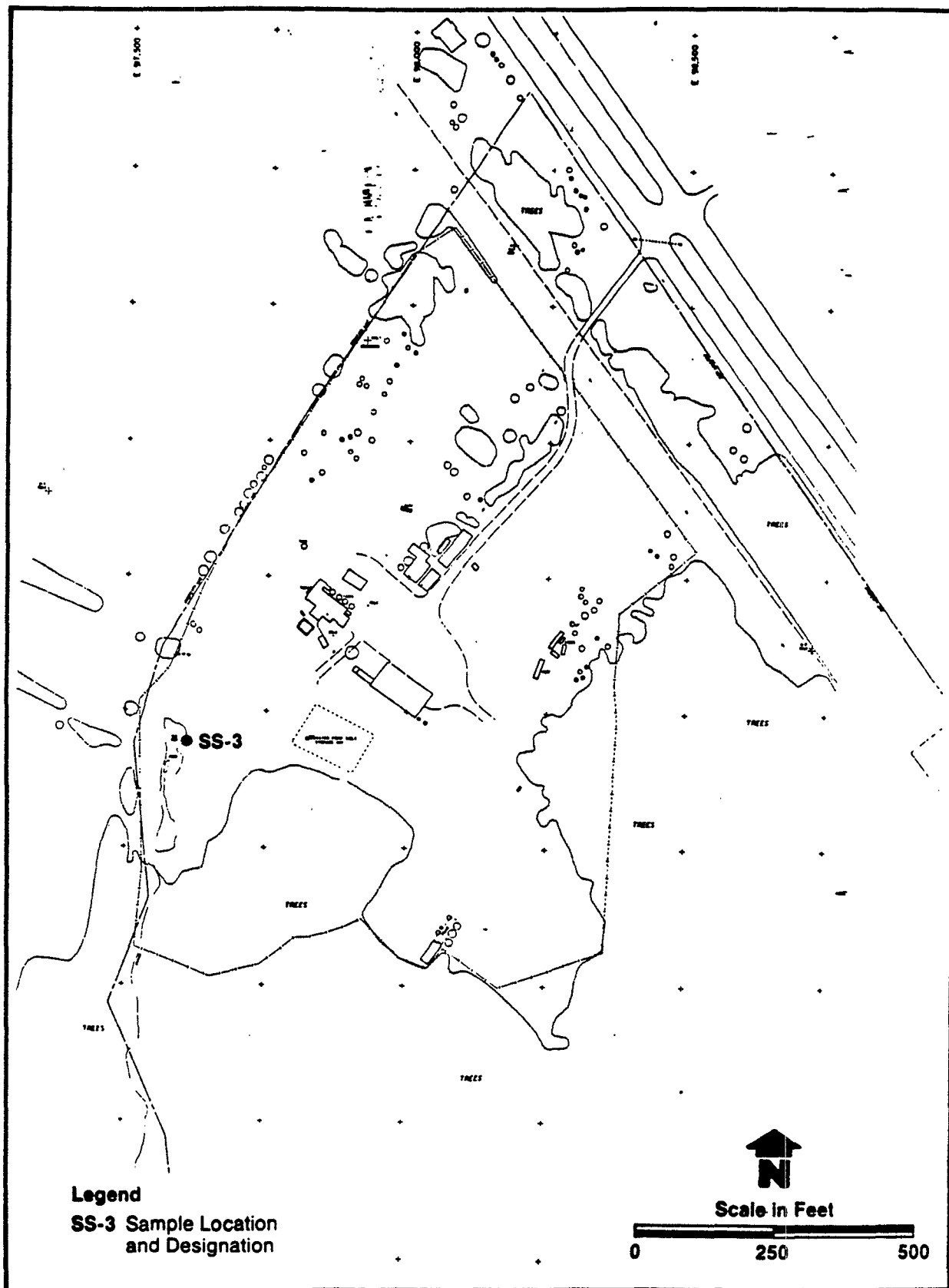


FIGURE 3-8 PHASE I SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

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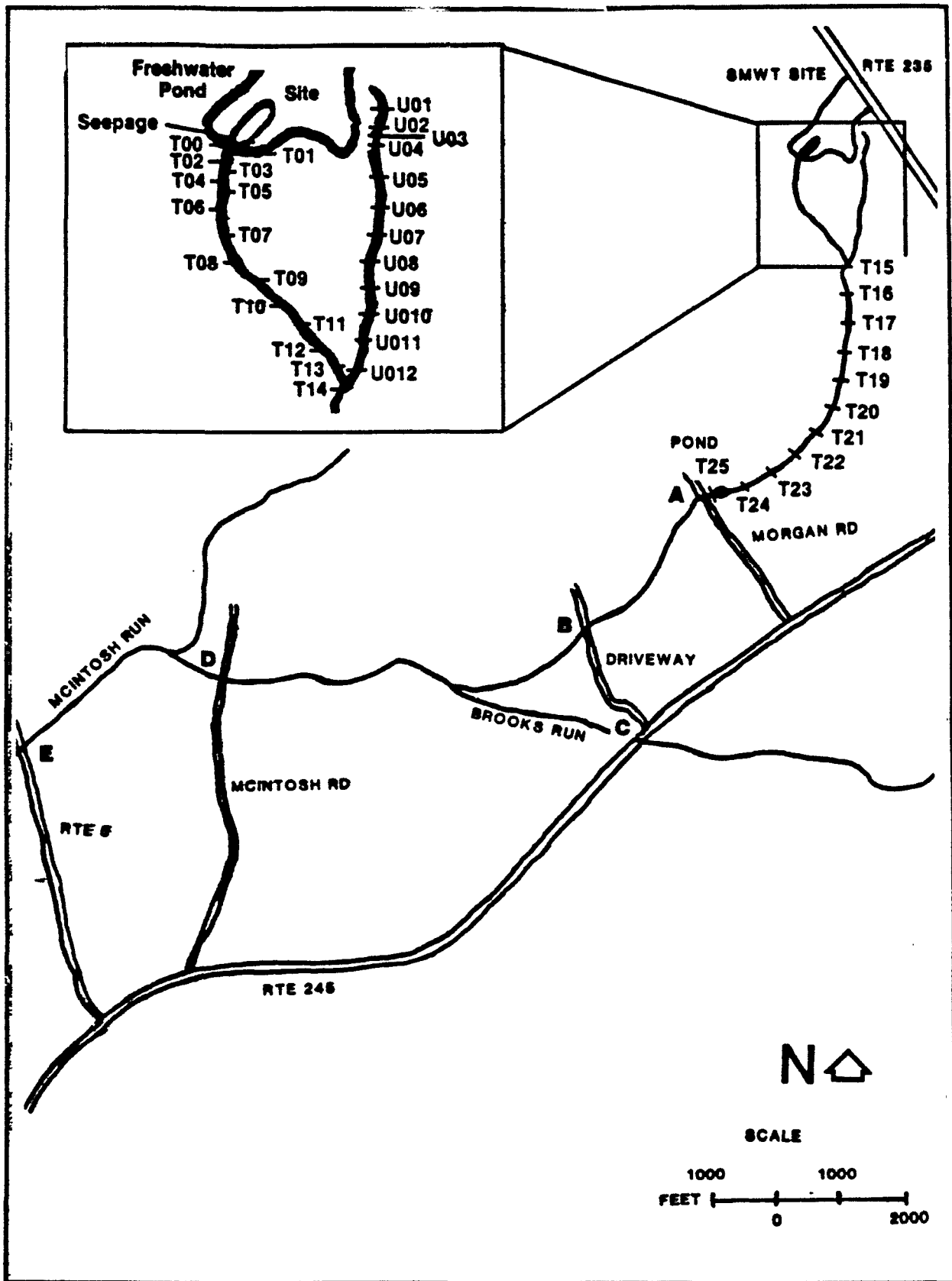


FIGURE 3-9 PHASE II SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

AR300870

Following a review of the data from the first round of surface water and sediment sampling, samples were collected at selected stations for off-site analysis using CLP or other EPA-approved laboratory methods. Chemical analyses were performed by Century Laboratories, Inc. A summary of the surface water and sediment sampling and analysis program is provided in Table 3-8. Analyses performed on surface water and sediment samples included:

- HSL organics
 - volatile organics
 - semi-volatile organics
- Selected metals
 - Aluminum
 - Chromium
 - Copper
 - Iron
 - Lead
 - Mercury
 - Zinc
- Total Organic Carbon
- Oil and Grease
- Water Quality Parameters (surface water samples only)
 - Biochemical Oxygen Demand
 - Chemical Oxygen Demand (COD)
 - Nitrate/Nitrite ($\text{N-NO}_3/\text{N-NO}_2$)
 - Acidity/Alkalinity
 - Phosphorous
 - Total Suspended Solids (TSS)
 - Total Kjeldahl Nitrogen (TKN)
- Congener specific and 2,3,7,8-substituted chlorinated dibenzodioxins and dibenzofurans

TABLE 3-8

SUMMARY OF PHASE II SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS PROGRAM

LOCATION	DISTANCE (FEET)	LOCATION (1) NUMBER	SAMPLE DATE	SAMPLE DEPTH INTERVAL	TEMPERATURE (°C)	pH	DISSOLVED OXYGEN (mg/L)	SPECIFIC CONDUCTIVITY (µmhos/cm)	UV SCREENING FOR PHAS	MSL VOCs	MSL VOLATILES (METALS)	SELECTED METALS (3)	TOTAL ORGANIC CARBON	OIL & GREASE PARAMETERS (4)	WATER QUALITY PARAMETERS (4)	BITUMENS & FUMES
IN-SITE																
Pond Composite	M/A	PC1	SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
Seepage Composite	M/A	SC1	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
WEST TRIBUTARY																
Distances measured from discharge from freshwater pond.	0	T00	SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	50	T01	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	100	T02	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	150	T03	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	200	T04	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	250	T05	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	350	T06	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	550	T07	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	750	T08	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	950	T09	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	1150	T10	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	1350	T11	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	1550	T12	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	1750	T13	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
EAST TRIBUTARY																
Distances measured from fence in land treatment area.	0	U01	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	100	U02	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	150	U03	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	200	U04	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	400	U05	SED	0-6"	X	X	X	X	X	X	X	X	X	X	X	X
	600	U06	SW	0-6"	X	X	X	X	X	X	X	X	X	X	X	X

AR300872

TABLE 3-B (CON'T)

SUMMARY OF PHASE II SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS PROGRAM

LOCATION	DISTANCE DOWNSTREAM (1) (FEET)	LOCATION NUMBER (2)	SAMPLE MATRIX	SAMPLE DEPTH INTERVAL	TEMPERATURE	pH	DISSOLVED OXYGEN	SPECIFIC CONDUCTIVITY	UV SCREENING FOR PHA	MSL VOL%	MSL SERI- VOLATILES	SELECTED METALS (3)	TOTAL ORGANIC CARBON	OIL & GREASE	WATER QUALITY PARAMETERS (4)	BIOTINS & FURANS
FROM CONFLUENCE OF EAST AND WEST TRIBUTARIES	800	U07	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	1000	U08	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	1200	U09	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	1400	U10	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	1600	U11	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	1800	U12	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
CONFLUENCE	1950	T14	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	2000	T15	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	2000	T16	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	3000	T17	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	3000	T18	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	4150	T19	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	4900	T20	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	5000	T21	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	5900	T22	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	6400	T23	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	8500	T24	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	7125	T25	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
INLET OF DOWNSTREAM POND	A	A	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	B	B	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	C	C	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	D	D	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	E	E	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
OUTLET OF DOWNSTREAM POND	A	A	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	B	B	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	C	C	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	D	D	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X
	E	E	SW	0-4"	X	X	X	X	X	X	X	X	X	X	X	X
			SED	6-12"	X	X	X	X	X	X	X	X	X	X	X	X
			SW	N/A	X	X	X	X	X	X	X	X	X	X	X	X

NOTES

- (1) Approximate distance measured from point indicated in location column.
 (2) SW = Surface Water, SED = Sediment.

(3) Aluminum, Chromium, Copper, Iron, Lead, Mercury, Zinc.
 (4) Nitrate/Nitrite, Phosphorus, Acidity/Alkalinity, TDS, BOD, Total Suspended Solids, Total Volatile Solids, Total Fixed Solids, Total Hardness.

AR300873

4.0 RESULTS OF THE REMEDIAL INVESTIGATION

4.1 GEOPHYSICAL STUDIES

4.1.1 GROUND PENETRATING RADAR (GPR) SURVEY

The radar profiles in Figure 3-1 typify the characteristic subsurface features encountered at the site. Intermittent stratigraphic (sand - clay) interfaces were detected between depths of 4 to 10 feet. Abrupt discontinuities within these units were seen in a number of radar profiles. These discontinuities are believed to represent the boundaries (trench walls) of the old excavated lagoon. The ground water interface was found at depths of 10 to 14 feet in the lower portions of the site south of the process area. The areal distribution of subsurface features and suspected locations of the old lagoons are plotted on an interpretive map of the subsurface, based on the results of the GPR study and are shown in Figure 4-1.

Four anomalies suspected to be the locations of the old lagoon were found, and their locations and approximate dimensions are shown in Figure 4-1. They ranged in depth from three to ten feet. A dense, highly conductive area was encountered south of the shed between grid nodes H6 and G7 where the ground surface was scarified. A pipe was detected below the surface running south from the process area.

Numerous discreet objects were seen in a number of profiles at depths ranging from ground surface to around 15 feet. The objects were located randomly across the site, as shown in Figure 4-2, and exhibited characteristic profile signatures generally associated with buried cobbles and boulders, scrap fill materials, pipes, and drums.

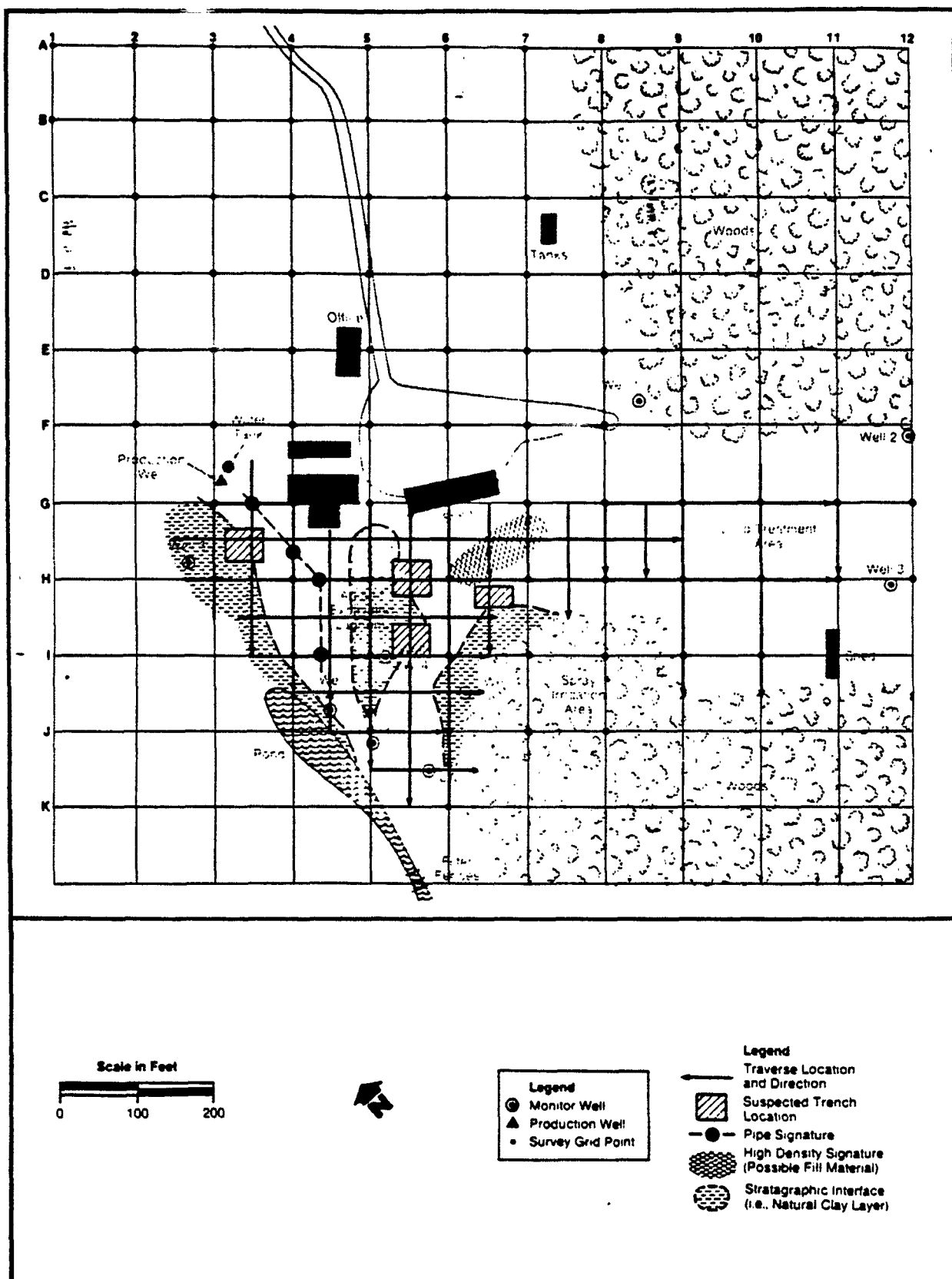


FIGURE 4-1 INTERPRETIVE MAP OF THE SUBSURFACE BASED ON THE GROUND PENETRATING RADAR RESULTS

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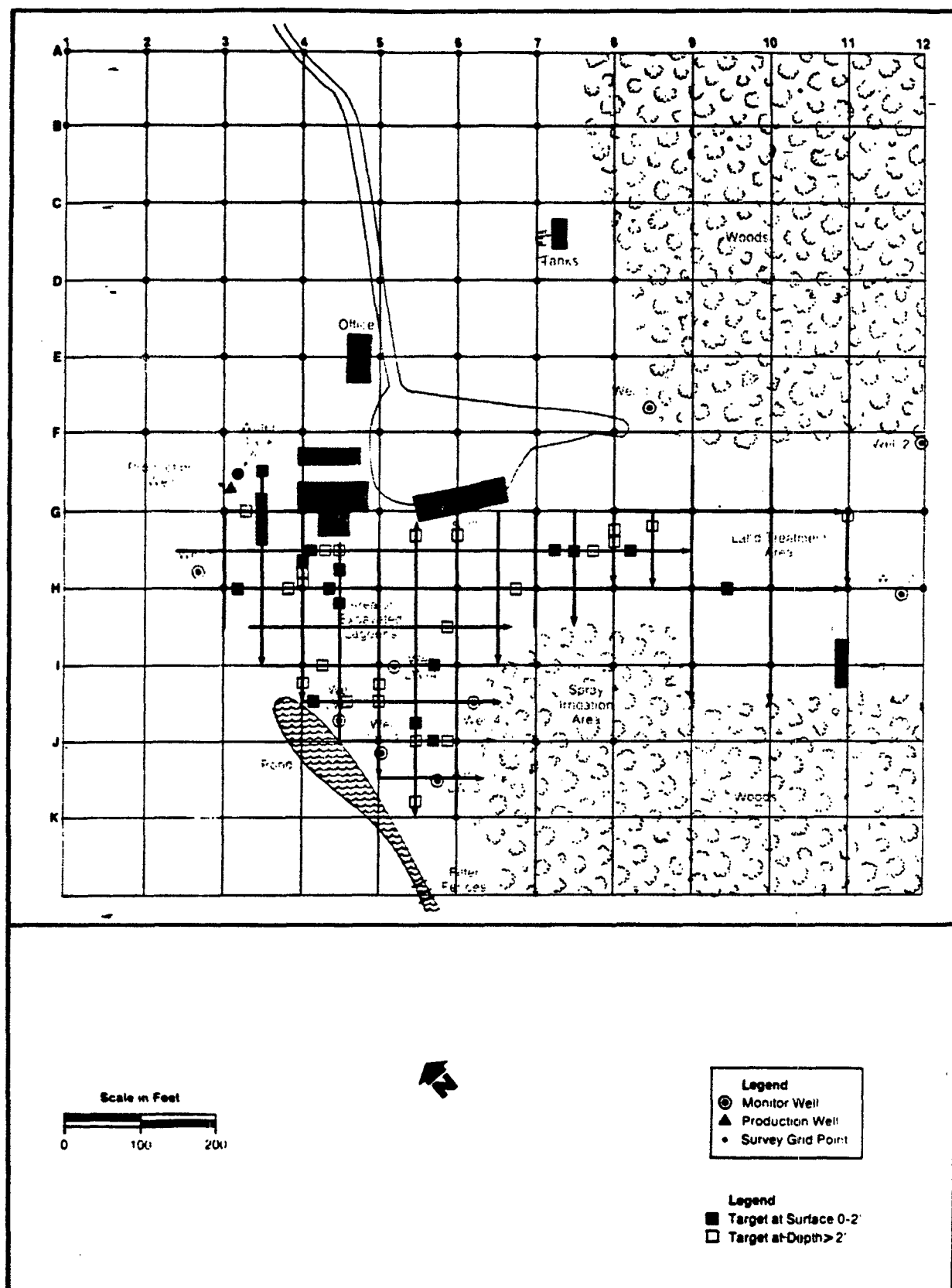


FIGURE 4-2 INTERPRETIVE GPR MAP OF SUBSURFACE
SHOWING DISCRETE BURIED OBJECTS

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4.1.2 TERRAIN CONDUCTIVITY SURVEY

Measurements of the terrain conductivity using the EM-34 at a 10-meter coil separation were plotted and contoured. The contour maps in Figures 4-3 and 4-4 represent the horizontal and vertical dipole data, respectively.

Background EM conductivity varied between 10 to 15 mmhos/m in the vertical dipole mode, and between 6 to 10 mmhos/m in the horizontal dipole mode. EM measurements within the range of background readings were recorded in the land treatment area, the spray irrigation area, and in the surveyed area north of the process buildings. In the northern half of the site, high conductivity anomalies were attributed to interferences from underground utilities and surface features such as overhead utility lines, site buildings and metallic debris. Measurements taken at grid node C4 were above background conductivity due to the influences of an adjacent pile of scrap metal. The electromagnetic influences from the site office building and a buried utility cable near grid node E4 resulted in abnormally high horizontal dipole measurements in this area.

South of the process area at grid node I4, a suspected buried pipe identified in the GPR survey resulted in elevated conductivity. Additionally, EM stations adjacent to the process area were influenced by their proximity to the site buildings and showed elevated conductivity readings.

The horizontal dipole and vertical dipole data outlined a pattern of elevated conductivity south to southwest of the process area in the reported area of the excavated lagoons. This trend in the EM conductivity may be related to changes in ground water quality, changes in soil conditions resulting from the lagoon excavation and backfilling, or the local occurrences of

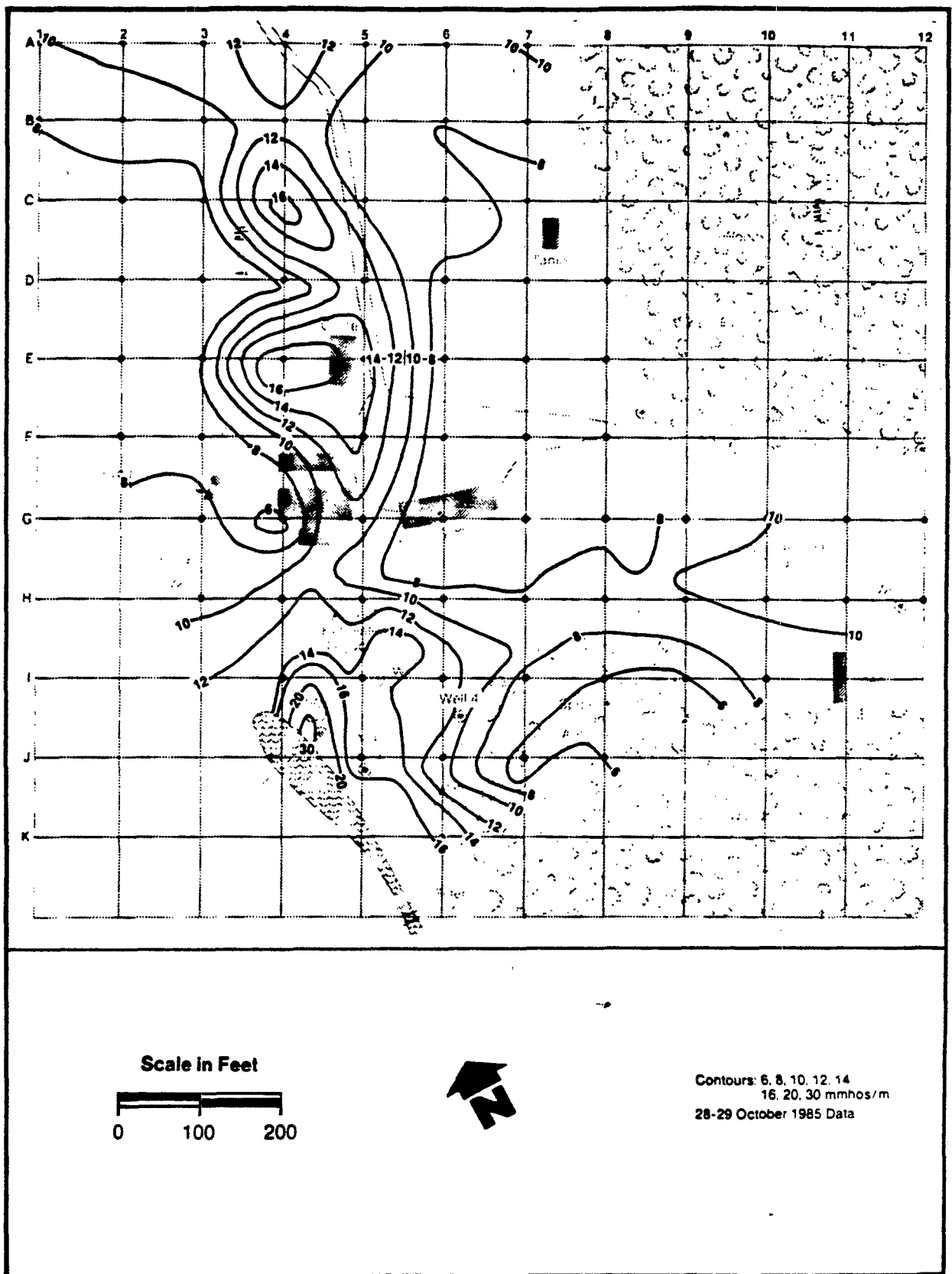


FIGURE 4-3 EM DATA-HORIZONTAL DIPOLE MODE

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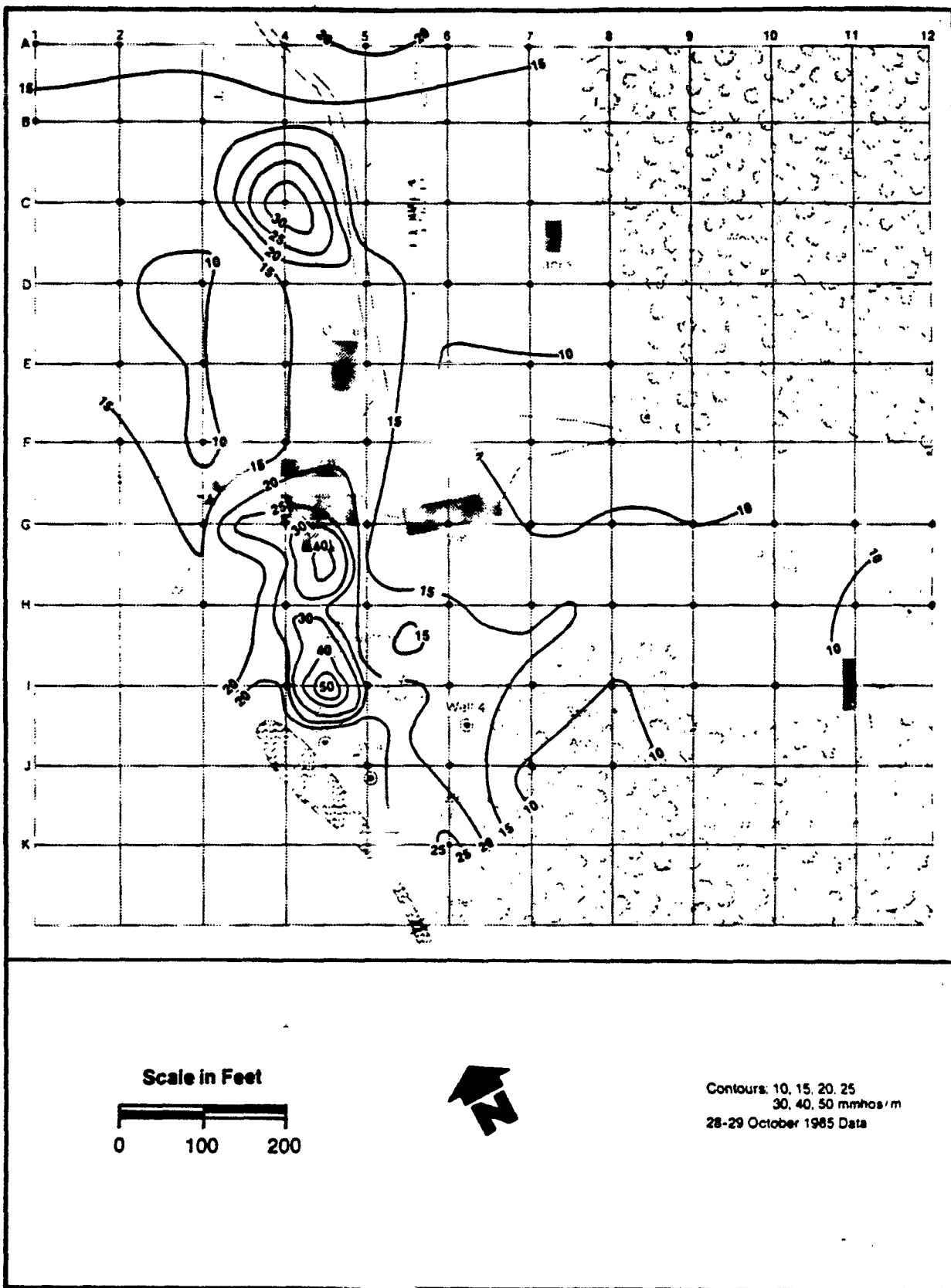


FIGURE 4-4 EM DATA VERTICAL DIPOLE MODE

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finer-grained geologic material. This data was used to select soil boring and monitor well locations during Phase II of the RI.

4.2 GROUND WATER STUDIES

4.2.1 GROUND WATER FLOW DIRECTION

Ground water flow direction investigations during Phase I RI activities indicated that the shallow ground water in the on-site Upland Deposits is flowing towards the east and west tributaries. This data, summarized in Table 4-1 and Figure 4-5, was used to site the monitor wells during Phase II.

Phase II RI investigations confirmed the ground water flow direction conclusions drawn from the Phase I data and further defined the ground water flow contours. Table 4-2 and Figure 4-6 present the ground water elevations and flow directions on-site as measured in August, 1986. Based on the August 1986 water level data, depth to water table at the monitor wells ranged from approximately 2.9 (MW-12) to 23.65 (MW-01) feet below ground surface. The thickness of the saturated Upland deposits above the clay layer (top of the Chesapeake Group) ranged from approximately 3.2 feet at MW-14 to 13.7 feet at MW-17.

As shown in Figure 4-6, ground water flow in the land treatment area is to the southeast towards the east tributary. The surface water in the east tributary is approximately 15 feet lower than the water levels in the monitor wells MW-02, MW-03 based on data from October, 1985. This suggests that the east tributary is an effluent stream, receiving ground water discharge.

TABLE 4-1

RI PHASE I WATER LEVEL ELEVATIONS

LOCATION	25-Oct-85 WATER LEVEL ELEVATION	29-Oct-85 WATER LEVEL ELEVATION
MONITOR WELL MW-01	78.24	78.44
MONITOR WELL MW-02	77.86	77.74
MONITOR WELL MW-03	77.85	78.12
MONITOR WELL MW-04	78.28	78.37
MONITOR WELL MW-05	81.91	81.71
PIEZOMETER LW-1	78.63	78.24
PIEZOMETER LW-2	78.97	77.80
PIEZOMETER LW-3	77.93	77.96
PIEZOMETER LW-4	79.96	79.23
FRESHWATER POND STAFF GAUGE SW-1	75.44	75.28
WEST TRIBUTARY STAFF GAUGE SW-2	65.82	65.81
EAST TRIBUTARY STAFF GAUGE SW-3	62.99	62.92
ON-SITE PRODUCTION WELL	-	-70.00

ELEVATIONS REFERENCED TO BENCHMARK.
ASSIGNED AN ELEVATION OF 100 FEET.

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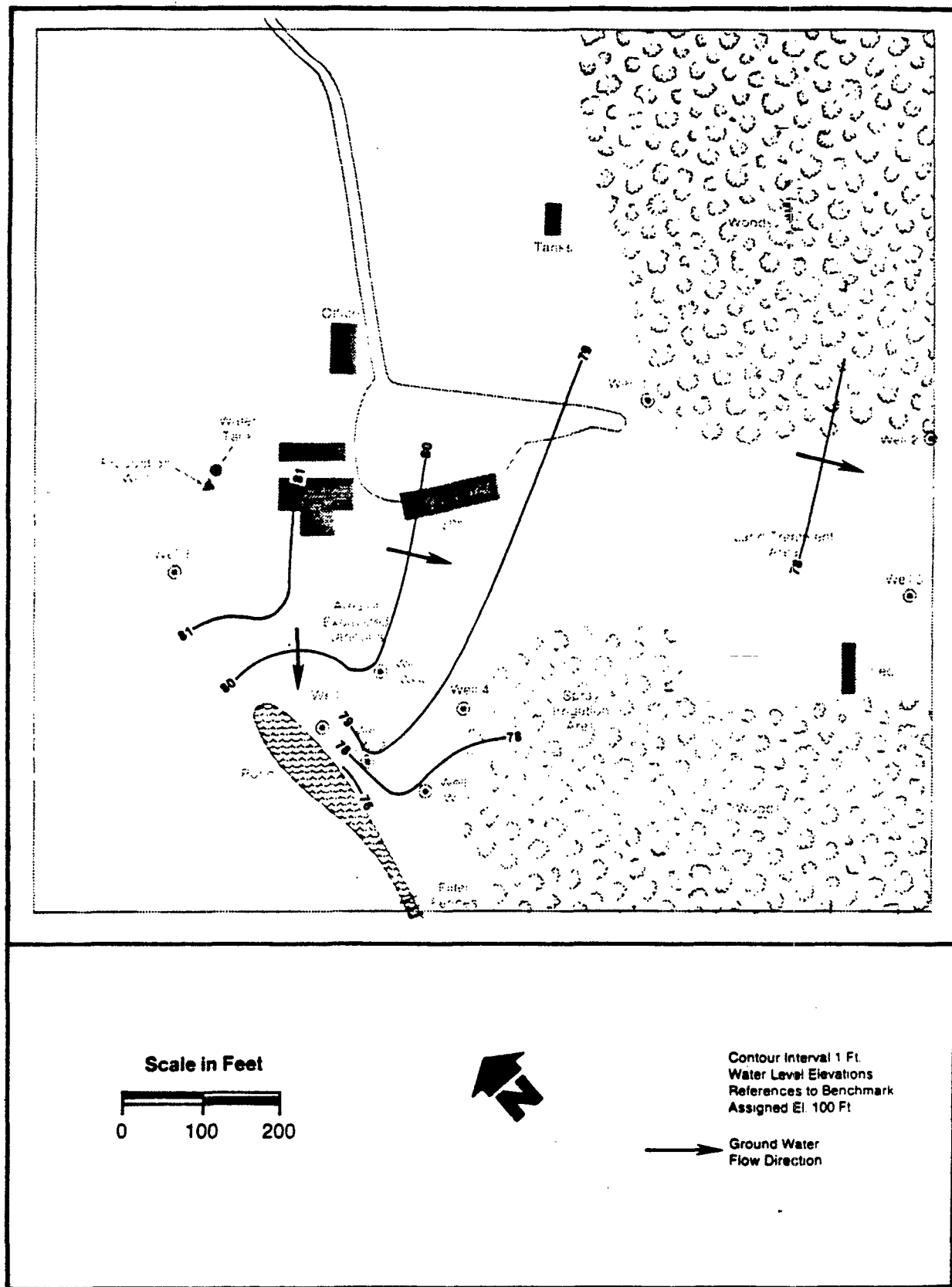


FIGURE 4-5 WATER TABLE MAP-25 OCTOBER 1985 DATA

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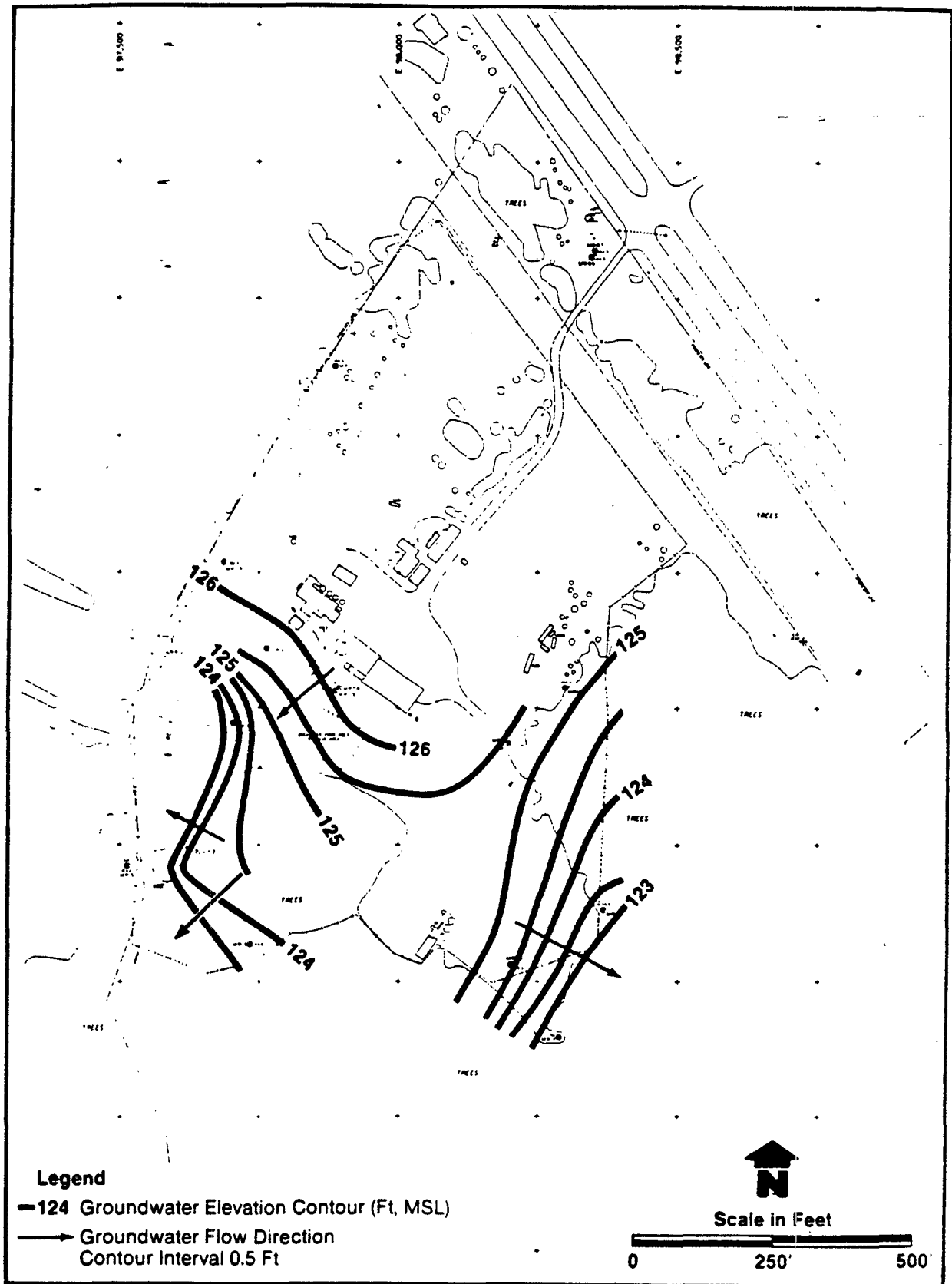
TABLE 4-2

RI PHASE II WATER LEVEL ELEVATIONS

LOCATION	AUGUST, 1986	APRIL, 1987
	WATER LEVEL ELEVATION (FT, MSL)	WATER LEVEL ELEVATION (FT, MSL)
MONITOR WELL MW-01	127.03	125.43
MONITOR WELL MW-02	125.40	123.32
MONITOR WELL MW-03	126.47	124.62
MONITOR WELL MW-04	126.32	124.75
MONITOR WELL MW-05	129.37	126.37
MONITOR WELL MW-06	126.47	124.77
MONITOR WELL MW-07	126.33	124.59
MONITOR WELL MW-08	127.82	126.11
MONITOR WELL MW-09	127.69	126.03
MONITOR WELL MW-10	126.78	125.31
MONITOR WELL MW-11	124.96	123.57
MONITOR WELL MW-12	125.66	124.28
MONITOR WELL MW-13	125.54	123.84
MONITOR WELL MW-14	124.45	122.22
MONITOR WELL MW-15	125.75	123.16
MONITOR WELL MW-16	127.79	125.55
MONITOR WELL MW-17	129.84	127.44

ELEVATIONS REFERENCED TO MEAN SEA LEVEL (MSL).

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**FIGURE 4-6 CONTOUR MAP OF GROUND WATER LEVEL ELEVATIONS
BASED ON 8/86 MEASUREMENTS**

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Ground water flow in the southwestern portion of the site, including the process area, the area of the excavated lagoons and the on-site pond, is partially directed to the southeast, but the majority of the ground water flows south to southwest and discharges into the on-site pond and the west tributary. During the site investigations, the surface water elevation in the pond was consistently lower than the water level elevations in monitor wells MW-11, MW-12, and MW-15 located adjacent to the pond. This data suggests that the freshwater pond and the west tributary are effluent surface water bodies receiving ground water discharge from the Upland Deposits.

The direction of ground water flow to the west of the pond cannot be described confidently from the available data. However, the water level elevation at MW-15 is approximately three feet above the surface water level in the west tributary. It is probable that the ground water flow in the Upland Deposits follows the ground surface contours and discharges to the freshwater pond and the west tributary.

The October 1985 depth to water measurements in the on-site production well, screened in the Aquia aquifer, indicated a water level at approximately 169 feet below ground surface. This water level elevation is approximately 145 to 152 feet lower than water levels measured in the shallow monitor wells. Due to the fact that the water level elevations observed in the Aquia aquifer are lower than the water table, a downward hydraulic gradient between the two aquifers exist, such that there is the potential for the downward migration of ground water from the Upland Deposits to deeper water-bearing zones.

4.2.2 GROUND WATER VELOCITY

The rate of ground water movement can be calculated by applying Darcy's law expressed as:

$$V = Ki/n$$

where:

- V = ground water flow velocity (L/T)
- K = average hydraulic conductivity (L/T)
- i = hydraulic gradient (dimensionless)
- n = effective porosity (dimensionless)

Based upon existing water level data, the hydraulic gradient (i) ranges from approximately 0.003 in the southeastern part of the site, to about 0.067 near the on-site pond. The effective porosity (n) for sands can range from approximately 25 to 50 percent. The value normally applied for a sand which contains trace to little silt and clay, such as those encountered on site, is 30 percent.

Two types of data were available for estimating hydraulic conductivity (k); specifically, slug test data and laboratory permeability data. During the RI Phase I Activities at the site, slug tests were performed on three existing site monitor wells. The tests primarily provide an estimate of horizontal permeability in the immediate vicinity of the well. The test method and hydraulic conductivity calculation methods are described in Section 3.5.2. Average hydraulic conductivity values derived from the slug tests ranged from 7.1×10^{-4} to 5.6×10^{-3} cm/sec (2.0 - 15.3 ft/day).

The second type of data available for estimating average hydraulic conductivity are laboratory permeability values. These values were obtained by measuring the rate of fluid movement

through relatively undisturbed soil samples (soil samples collected in Shelby Tubes) and are considered indicative of vertical permeability of the given soil samples.

Hydraulic conductivities calculated for the sand samples collected in soil borings B-02 and B-04 were 9.7×10^{-6} cm/sec and 2.7×10^{-5} cm/sec (0.028 and 0.077 ft/day), respectively. Hydraulic conductivities for the two clayey soil samples collected in B-04 and B-12 were 3.6×10^{-8} cm/sec and 1.9×10^{-6} cm/sec (0.00001 and 0.0005 ft/day), respectively.

For the clayey silts, the hydraulic conductivity values seem reasonable, the range of results being within what could be expected for vertical permeability tests performed on fine grained deposits.

For the sands, the values from the laboratory permeability tests (9.7×10^{-6} cm/sec and 2.7×10^{-5} cm/sec) are roughly two to three orders of magnitude below the values obtained from the slug tests. The laboratory tests represent vertical permeabilities which are generally lower than horizontal permeabilities, while the slug tests represent primarily horizontal permeability in the immediate vicinity of each well. In addition, the small size of the laboratory samples typically show less permeability than full-size field tests because the small lab samples are not influenced by the radial effects from cleaner sand lenses in the formation. For purposes of calculating rates of ground water migration, values of 2.7×10^{-5} cm/sec and 7.1×10^{-4} (0.077 - 2.0 ft/day) were used. These values represent the intermediate values obtained from the slug tests and laboratory permeability tests.

Substituting the values for the variables given in the Darcy's Law equation, ground water velocities in the Upland-deposits in the immediate site area are estimated to range from 0.017 to 0.020 ft/day.

4.2.3 GROUND WATER QUALITY

4.2.3.1 Residential Well Water Quality

Water samples collected from residential wells in the vicinity of the SMWT site were analyzed for BTX and HSL semivolatiles. None of these compounds were detected in any of the residential well samples.

4.2.3.2 Shallow On-Site Ground Water Quality

As presented in Table 4-3 and Figure 4-7, on-site ground water contamination in the water table aquifer appears to be localized in an area roughly bounded by monitor wells MW-08, MW-12 and MW-05. With the exception of monitor wells MW-01, MW-02 and MW-15 contaminant concentration levels in ground water from all other wells were below method detection limits.

The ground water samples from monitor wells MW-01 and MW-03 were found to contain a trace amount (estimated at 4 ug/L and 2 ug/L, respectively) of phenol.

Ground water from monitor well MW-15 was found to contain 21 ug/L of PNAs. These results are anomalous because the potential for ground water to migrate beyond the pond in the direction of MW-15 is not supported by the following RI field data:

- A comparison of water level elevation data from MW-15 and the pond shows that the apparent direction of ground water flow is towards the pond in this area.

TABLE 4-3

SUMMARY OF ANALYTICAL RESULTS FOR GROUND WATER SAMPLES
(All results in ug/L)

MONITOR WELL NUMBER	BTX	TOTAL PNAs	PCP	OTHER ACID EXTRACTABLES	OTHER BASE/NEUTRAL EXTRACTABLES	DIOXINS AND FURANS (1)
MW-01	ND	ND	ND	4	ND	ND
MW-02	ND	ND	ND	ND	ND	ND
MW-03	ND	ND	ND	2	ND	ND
MW-04	602	5391	1300	8000	130	130
MW-05	ND	1647	920	1670	43	43
MW-06	ND	ND	ND	ND	ND	ND
MW-07	ND	ND	ND	ND	ND	ND
MW-08	2840	92290	5000	46600	7900	7900
MW-09	123	92	ND	886	19	0.000
MW-10	ND	ND	ND	ND	ND	ND
MW-11	460	9232	1300	37600	420	(2)
MW-12	300	280	500	830	22	22
MW-13	ND	ND	ND	ND	ND	ND
MW-14	ND	ND	ND	ND	ND	ND
MW-15	ND	21	ND	ND	ND	ND
MW-16	1320	90200	1500	4930	4300	4300
MW-16 DUPLICATE	336	58418	1100	33	4900	4900
MW-17	ND	1	ND	ND	ND	ND

(1) DIOXIN DATA IS TOXICITY EQUIVALENT FACTOR (TEF) IN ug/L.

(2) VALUES WOULD NOT BE CALCULATED DUE TO SEVERE MATRIX EFFECTS DURING ANALYSIS FOR TETRA/PENTA CONGENERS. HEXACHLORINATED DIBENZODIOXINS AND DIBENZOFURANS WERE DETECTED IN THIS SAMPLE.

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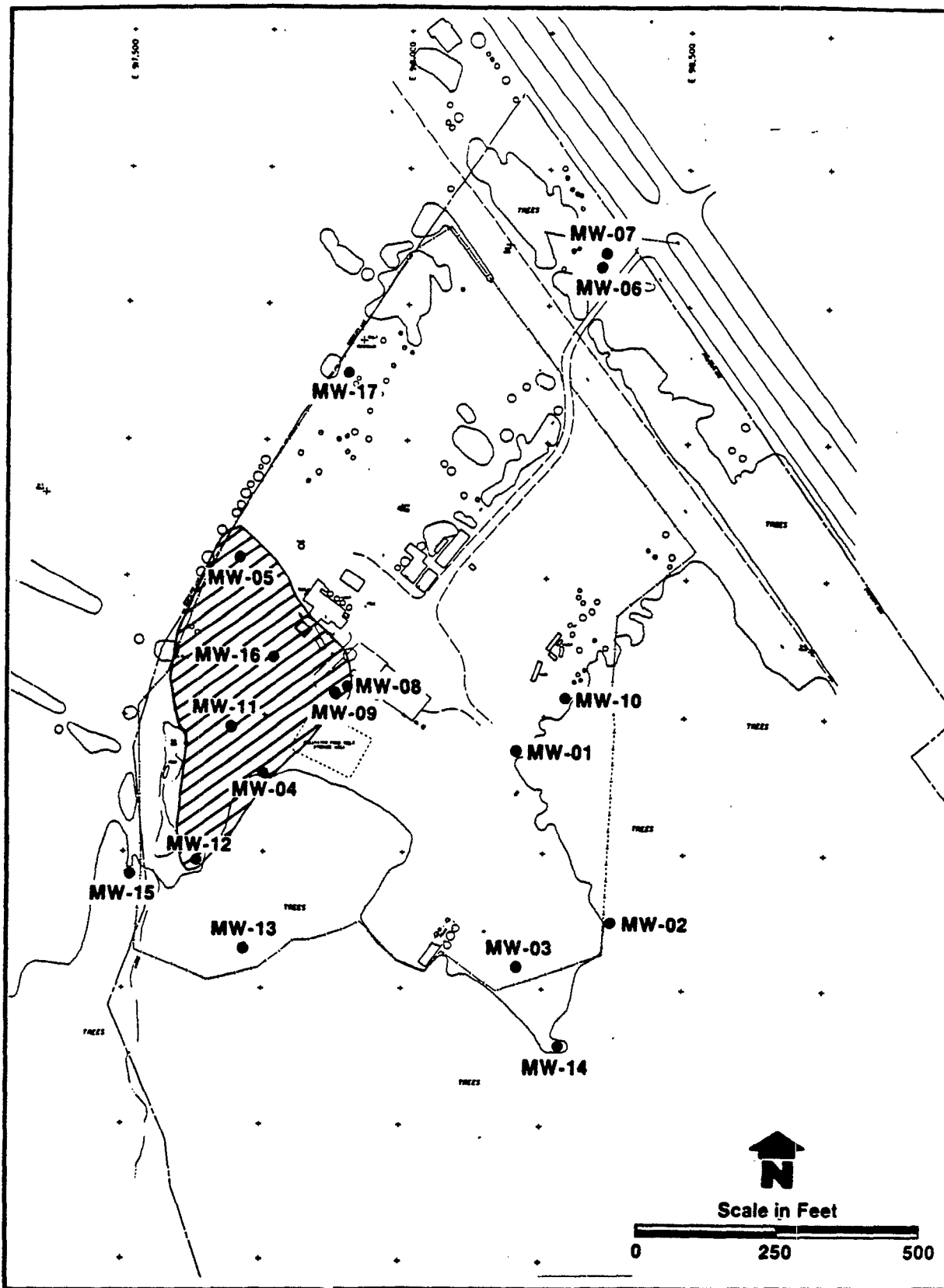


FIGURE 4-7 MAP DEPICTING THE AREA WHERE MONITOR WELL
SAMPLES CONTAINED GREATER THAN 20 ppb TOTAL PNAs

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- The elevation of the top of the clay layer is approximately three feet higher at MW-15 than at MW-12, located on the opposite side of the pond. The higher top of clay elevations at MW-15 would prohibit contaminants that are migrating on the clay layer from reaching this location.

It is expected that the resampling of MW-15 and the installation and sampling of additional ground water monitor wells during RI Phase III will provide the data necessary to define ground water flow and quality west of the pond.

The shallow ground water in the area southwest of the former processing facility (i.e., the approximate area of the former unlined lagoons) is contaminated with volatile and semivolatile contaminants in the tens-to-hundreds of parts per million range (Table 4-3). The most commonly occurring contaminants include benzene, toluene, pentachlorophenol, phenol, 2-methyl phenol, 2,4-dimethylphenol, dibenzofuran, and several PNAs. The most commonly occurring PNAs include naphthalene, 2-methylnaphthalene, acenaphthylene, fluorene, phenanthrene, fluoranthene, and pyrene. Many of these compounds are at least partially water soluble and would be expected to travel with the shallow ground water. A portion of this ground water discharges to the freshwater pond and west tributary.

The presence of contaminants in the shallow ground water in the area of the excavated lagoons is consistent with the historical use of this area for waste disposal. Notably, soil staining was observed in the saturated soils directly above the clay layer during soil boring activities in this area. OVA and HNu scans of the stained soil indicated the presence of volatile organic compounds. There was no obvious staining in the underlying clay layer.

A comparison of the water quality in monitor wells MW-08 and MW-09 indicates the significance of the soil discoloration. During construction of monitor well MW-08, a stained soil was encountered at depths from 26 to 27.5 feet below ground surface (116.0 - 118.5 feet MSL). Monitor well MW-08 was screened over the interval from 24 to 29 feet (115.5 - 120.5 MSL). The adjacent well, MW-09, was screened over the depth interval of 13 to 23 feet below ground surface or approximately three feet above this stained layer. The contaminant concentrations in ground water from monitor well MW-08 are two to three orders of magnitude higher than those found in monitor well MW-09. These results indicate that the contaminants found in the wells in this area tend to be soluble or sinking (i.e., more dense than water). Monitor well MW-09 would have had higher contaminant concentrations than MW-08 if the site contaminants had been predominantly floating as opposed to sinking types.

The concentrations of acenaphthene, fluorene, phenanthrene, fluoranthene, and pyrene in ground water samples from monitor wells MW-08 and MW-16 were in excess of the reported solubilities of these compounds in water. Furthermore, a black hydrocarbon-like phase was detected in saturated soils and ground water in the area of these wells. It appears that this hydrocarbon-like phase is increasing the contaminant holding capacity of the ground water by providing a more effective solvent for site contaminants.

The dioxin analyses performed on ground water samples from monitor wells MW-09 and MW-11 are inconclusive. No chlorinated dibenzodioxins were found in the ground water sample collected from monitor well MW-09. As discussed earlier, this well was screened above the stained soil found in the adjacent monitor well MW-08. Since dioxins are nearly insoluble in water (although they are reasonably soluble in oil), this result would be reasonable.

The ground water sample collected for dioxin analysis from monitor well MW-11 contained significant amounts of a black hydrocarbon-like material. Preliminary analysis indicated that this sample possibly contained dioxins and furans, however, severe matrix problems were encountered in replicate analyses and the data were judged to be essentially unusable. Resampling is recommended as part of the Phase III RI activities.

4.3 AMBIENT AIR QUALITY

4.3.1 REAL-TIME AIR MONITORING

The results of real-time air monitoring for respirable particulates conducted on June 4 and 5, 1986 determined that respirable dust concentrations in the vicinity of the tanks on the north-eastern side of the site were below the instrument detection limit of 0.01 mg/m^3 for all samples except for the 8:40 AM sample on June 4 where a value of 0.04 mg/m^3 was recorded. Time-weighted average concentrations for respirable particulates were below the instrument detection limits. Figure 4-8 depicts the mini-RAM sampling locations.

Measurements for volatile organic compounds were taken during drilling and test pitting activities. Volatile organic compounds in the breathing zone did not exceed 5 ppm as measured by the HNu photoionization detector.

4.3.2 TIME - WEIGHTED AVERAGE SAMPLING

The concentrations of PNAs, HSL volatile organic compounds (VOCs), and pentachlorophenol were below detection limits in all time-weighted average sampling performed August 5, 1986. The only anomalies apparent from a review of data are the high

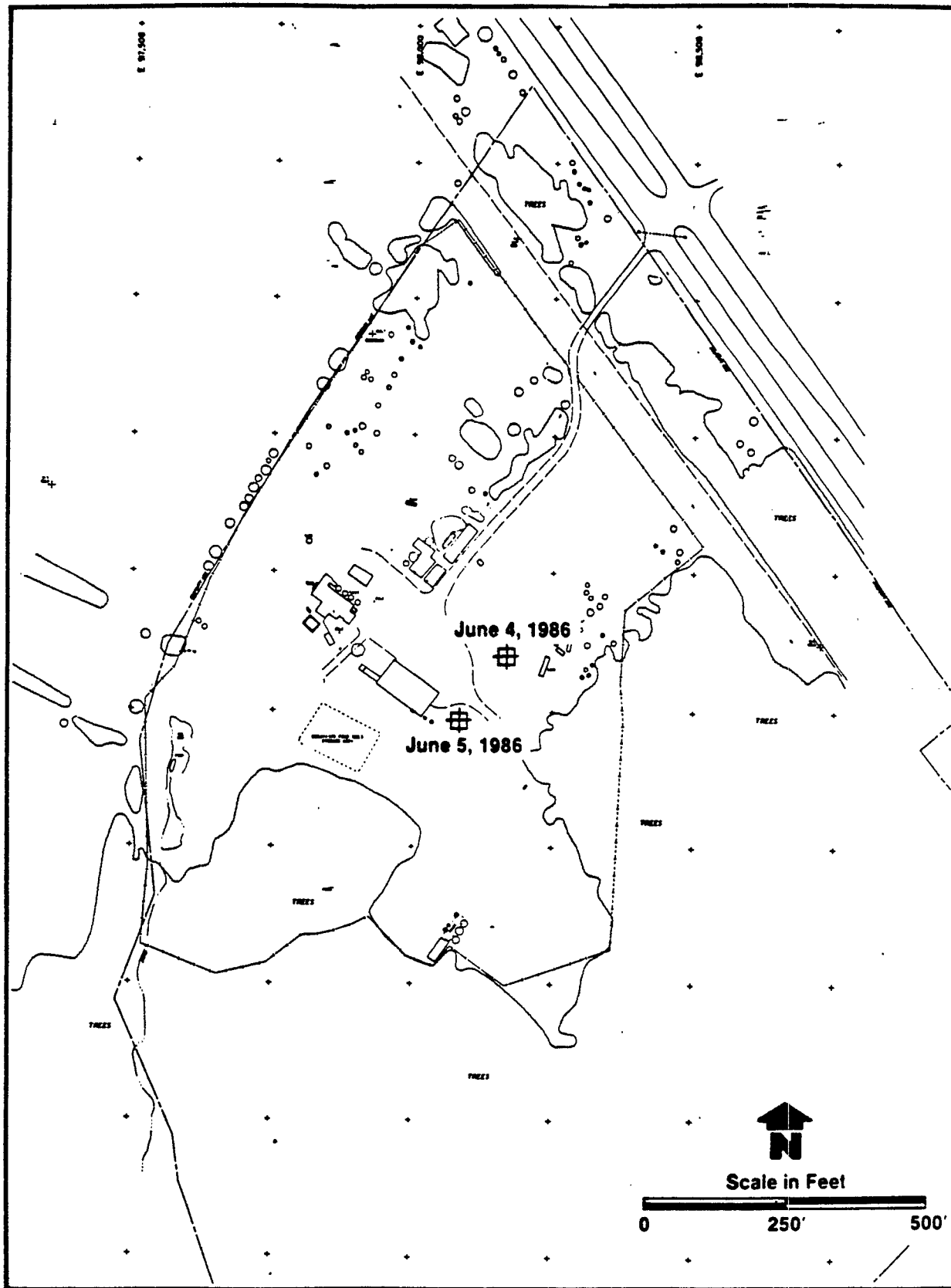


FIGURE 4-8 SAMPLING LOCATIONS FOR mini-RAM

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detection limits for carbon disulfide and the trace amount of naphthalene detected at station AM-2. Station AM-2 was located adjacent to the tanks in the northeast portion of the site. The sampling locations were depicted in Figure 3-4.

Carbon disulfide is a residue of the desorbing process used in performing the chemical analysis for VOCs and would not be expected to be present on-site. This conclusion is supported by the similar results found for the blank samples.

Naphthalene was identified in the sample from air station AM-2 at trace levels. The quantification of these levels, which were below the method detection limits, could only be estimated as 0.003 mg/m³ air.

4.4 SOILS

The results of the soils investigation are presented in four subsections and are addressed in the following categories:

- Background Soils - The background soils are considered off-site and upgradient of the contaminant source. The soils encountered during the drilling of ground water monitoring wells MW-06 and MW-07 will be used for representation of the background surface and subsurface soil conditions.
- Surface Soils - The surface soils include the uppermost soil deposits investigated during the RI. This study will consider the upper two feet of soils as the surface soils.
- Subsurface Soils - The subsurface soils are those deposits which underlie the surface soils. Stratigraphic cross-sections were prepared based on soil boring and monitoring well soil data. The soil stratigraphy is characterized down to an elevation of approximately 108 ft. above MSL.

- Summary - A summary of the results of the soils investigation and an estimation of soil volumes potentially requiring remediation is included in this subsection.

4.4.1 BACKGROUND SOILS

4.4.1.1 General

The background soil investigation was performed off-site and upgradient of the SMWT site facility and contaminant sources to provide information and data to characterize the conditions of the uncontaminated, natural soils.

4.4.1.2 Soils Encountered

The background soils are represented by those soils encountered during the drilling of monitor wells MW-06 and MW-07. Monitor well MW-06 is located approximately 100 feet north of the SMWT site facility entrance and 50 feet west of the entrance road. An additional monitoring well was placed about 25 feet north of MW-06 and is identified as MW-07. Continuous sampling and logging were not performed during the drilling of MW-07. The soil profile at MW-06 consists of multi-colored interbeds of fine sands, silty sands and silt/clay. A white to brownish-gray clayey silt to silty clay layer was encountered from 11 to 17 feet below ground surface (el. 133.5 to 127.5 MSL).

The remaining soil encountered to a depth of 30.5 feet was predominantly a silty sand to sand. Below 30.5 feet (el. 114 feet MSL), a plastic, yellowish-brown, silty clay layer was encountered which graduates to a dark grayish color at a depth of 35 feet below ground surface. Soil boring data indicate that the silty clay layer is overlain by approximately 10 feet of saturated sand. The soil boring was terminated within the dark gray silty clay at a depth of 37 feet.

No geotechnical analyses were performed on either MW-06 or MW-07. Further discussions on subsurface soil properties at the SMWT site will be presented in Section 4.4.3.3.

4.4.1.3 Analytical Results

The analytical results for soil samples collected from monitor well MW-07 are summarized in Table 4-4. A sample collected from a depth interval of 5.0 to 6.5 feet (el. 139.5 to 138.0 feet MSL) contained 590 mg/kg of isophorone. No other HSL organics were detected in the samples collected from MW-07.

The metals content of the brown silty medium to fine sand encountered at 5.0 to 6.5 feet (el. 139.5 to 138 feet MSL) were generally higher than those at the orange silty medium to fine sand encountered at 21.5 to 23.0 feet (el. 123.0 - 121.5 feet MSL). The metals concentrations detected in the background samples are within the range of typical metals concentrations as reported in reference literature.

4.4.2 SURFACE SOILS

4.4.2.1 Objective

This subsection addresses the soils encountered in the upper two feet of the borings and test pits. Surface soil samples were not taken at monitoring well locations. This section will discuss the nature and thickness of the top soil and the immediate underlying soil. In some cases, native top soil was not present due to site practices, thus the nature of the surficial or fill materials will be described.

TABLE 4-4

SUMMARY OF ANALYTICAL RESULTS
FOR BACKGROUND SOIL SAMPLES

Sample Number	MW07-001	MW07-002	MW07-003
Sampling Interval (ft.)	5.0-6.5	20.0-21.5	21.5-23.0
Total VOCs, ug/kg	ND	ND	ND
Total PNAs, ug/kg	ND	NT	ND
Pentachlorothenol, ug/kg	ND	ND	ND
Other Acid Extractable Organics, ug/kg	ND	ND	ND
Other Base/Neutral Organics, ug/kg	590	ND	ND
Aluminum, mg/kg	8460	NT	1360
Chromium, mg/kg	8.9	NT	3.2
Copper, mg/kg	4.2	NT	NV
Iron, mg/kg	9210	NT	1520
Lead, mg/kg	7.7	NT	1.5
Mercury, mg/kg	0.53	NT	0.1
Zinc, mg/kg	10	NT	2
Total Organic Carbon, ug/kg	1,250,000	NT	NT
Oil & Grease, ug/kg	<33,400	NT	NT

ND = Not detected
 NT = Not tested
 NV = Not validated
 < = Less than

All results reported on a dry weight basis.

The types and properties of surface soils are significant because much of the contamination at the site resulted from surface disposal, spillage, and drippage from finished products. The permeability, cohesiveness, and adsorptive properties of these surface soils are controlling factors in the migration of contaminants to subsurface soils and ground water, or transport of contaminants through airborne particulates and/or surface runoff.

4.4.2.2 Soils Encountered

Soils from the borings and test pits indicate fill materials are present in areas within the land treatment area, the upper (northern) site and the parking area by the SMWT site facility office (refer to Figure 1-4). The fill material in the land treatment area is generally between one to two feet thick and is primarily composed of a brown silty sand to sand. Wood chips or fragments are present within the fill material with occasional assorted debris consistent with the land farming operations which took place in this area during the previous remediation. The fill was typically loose and dry under field conditions. The fill encountered in the other areas listed above was generally silty sand or a gravel aggregate which was used for the access roads and parking areas.

In areas lacking fill, a brown to dark brown silty fine sand and top soil was noted. The top soil thickness ranged from 4 to 12 inches throughout the site. The material was generally poorly graded, loose to medium dense and dry to moist, depending on the location. The top soil near the pond appeared to have a higher moisture content based upon field observation. The top soils generally graduated to a brown to orange-brown, silty fine sand or clayey fine sand. They are typically poorly graded, medium dense and moist under field conditions. Figure 2-3 illustrates the surface soil deposition in the vicinity of the site.

The resistance to erosion for the surface soils at SMWT site are somewhat low due to lack of cohesiveness within the soil aggregate. In general, the surface soils at the site are subject to moderate to high erosional rates. The degree of erosion is evident by observations of the significant erosional features at the site, especially in the excavated lagoon area.

4.4.2.3 Analytical Results

The analytical results for surface soil samples (0-2 foot depth interval) are summarized by area in Table 4-5. The areas described are depicted in Figure 4-9. The most frequently identified organic compounds are listed in Table 4-6. Dioxin results are summarized separately in Table 4-7.

The analytical results are consistent with the operating history and remedial activities that have occurred at the site. HSL organic contamination in the surface soils is widespread and does not follow any specific pattern.

The surface soils in the land treatment area are the most contaminated surface soils at the SMWT site. This is consistent with the land farming of lagoon sludges in this area. The maximum total PNA concentration in the land treatment area was 4,120,000 ug/kg (test pit TP08).

The surface soils in the excavated lagoons area also contain elevated concentrations of PNAs. A sample collected from test pit TP10 contained approximately 1,690,000 ug/kg total PNAs. The northern part of the site, including the northeast tank area and the upper site area, showed widely variable contaminant concentrations. Total PNA concentrations ranged from non-

TABLE 4-5
SUMMARY OF ANALYTICAL RESULTS OF SURFACE SOIL SAMPLES

AREA	VOCs (ug/kg)	PM10 (ug/kg)	PCP (ug/kg)	OTHER ACID EXTRACT- ABLES (1) (ug/kg)	OTHER BASE/ NEUTRAL EXTRACT- ABLES (1) (ug/kg)	FIELD SCREENING FOR PM10 (ug/kg)	OIL AND GREASE (ug/kg)	TOTAL ORGANIC CARBON (ug/kg)	ALUMINUM (ug/kg)	CHROMIUM (ug/kg)	COPPER (ug/kg)	IRON (ug/kg)	LEAD (ug/kg)	MERCURY (ug/kg)	ZINC (ug/kg)
Upper Site	ND	ND - 20,900	ND	ND	ND	ND - 49,000	61,000	6,440,000	3,440 - 13,300	5.3-10	4.4-7.2	3,670 - 10,820	ND-80	0.1	12-24
Northeast Tank Area	ND	ND - 130,000	ND - 120	ND	ND	ND - 43,000	---	---	0,090 - 20,900	ND-15	3-11	4,820 - 10,400	ND-134	0.1	5-39
Lead Treatment Area	ND - 14,200	700 - 4,120,000	ND - 190	ND	ND	ND - 53,000	83,000 - 6,120,000	6,440,000 - 14,000,000	7,130 - 9,990	ND-75	ND-82	7,130 - 19,500	ND-32	ND-0.46	2-141
Spray Irrigation Area	ND	ND	ND	ND	ND	ND	---	---	4,890 - 15,300	16	6.5	4,710 - 14,500	ND-6.6	0.1-0.2	2.6-14
Freshwater Pond Area	ND	ND - 5,920	ND - 340	ND	ND	ND - 2,200,000	---	---	15,000	15	11	12,000	ND	0.1	45
Excavated Lagoons Area	ND - 2,420	30,100 - 1,490,000	ND - 79,000	ND	1,340 - 230,000	ND - 4,900,000	1,420,000	4,200,000	7,160	9.2	ND-6.6	18,000	ND-10	ND-0.11	2-13
Process Area	ND	ND - 1,290	ND	ND	ND	ND - 53,000	130,000	543,000	ND-25,000	ND-21	ND-9.9	6,670 - 19,200	ND-10	0.00-0.11	2-41

(1) A list of acid extractable and base/neutral extractable compounds is provided with the analytical data in Appendix F.

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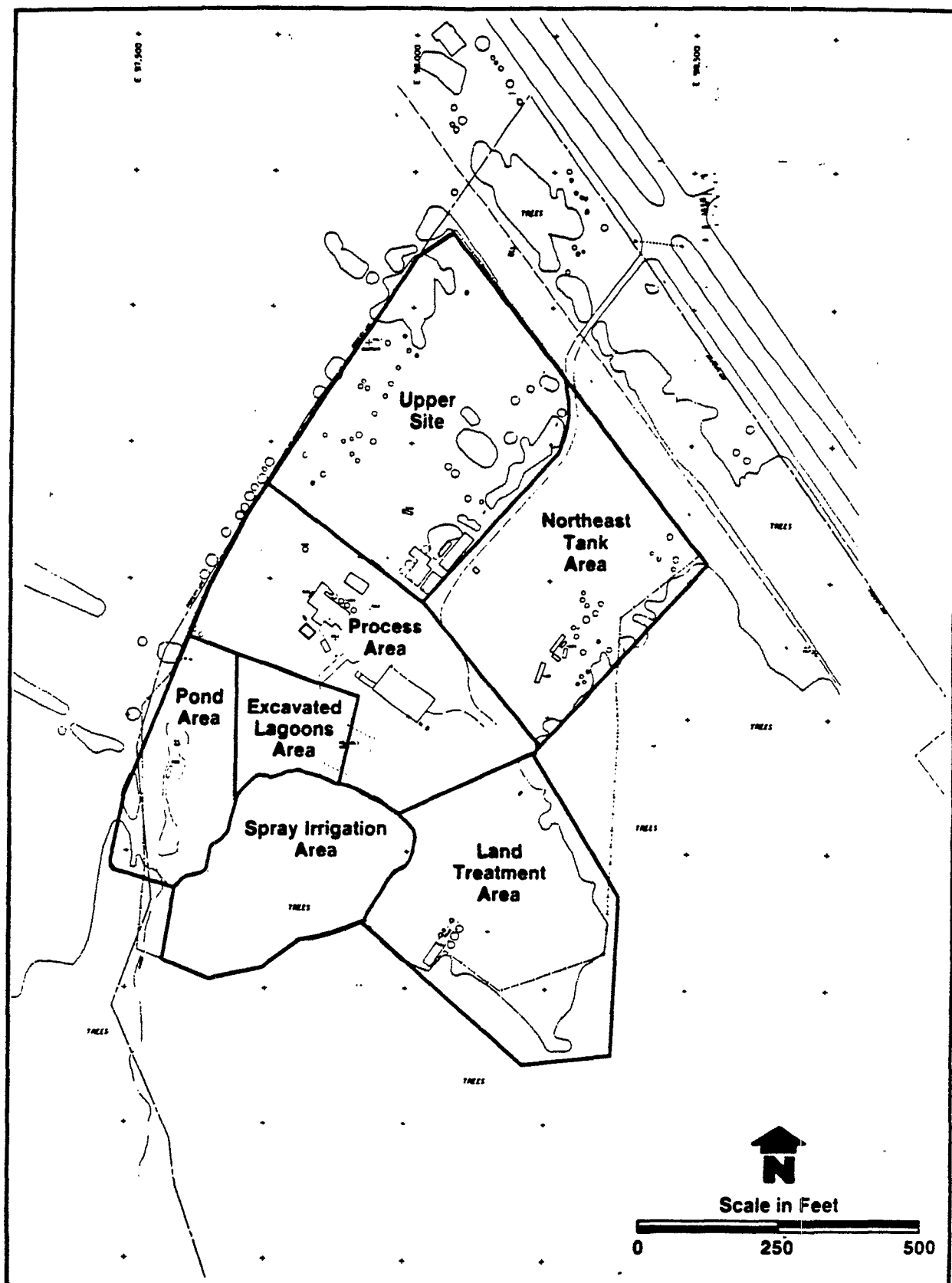


FIGURE 4-9 SITE SKETCH DEPICTING AREAS LISTED IN TABLE 4-5

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TABLE 4-6
ORGANIC COMPOUNDS MOST FREQUENTLY IDENTIFIED
IN SURFACE SOIL SAMPLES

VOLATILE ORGANIC
COMPOUNDS

Acetone

Toluene

Ethylbenzene

Styrene

Xylenes

POLYNUCLEAR
AROMATICS

Fluroanthene

Pyrene

Benzo(a) Anthracene

Benzo(a) Pyrene

OTHER BASE/NEUTRAL
EXTRACTABLES

Dibenzofuran

TABLE 4-7

SUMMARY OF DIOXIN/FURAN RESULTS FOR SURFACE SOIL SAMPLES

AREA	SAMPLE NUMBER	TOTAL TEF (ug/kg)
UPPER SITE	B1-001	0.000
	SS3-001	0.000
NORTHEAST TANK	SS6-002	0.000
	SS6-003	0.000
	T10-002	0.017
	T10-001	0.036
FRESHWATER POND	B2-001	0.000
LAND TREATMENT	B3-001	0.426
	B4-001	0.488
PROCESS	B7-001	0.006
	B10-001	0.024
	B9-001	0.765
EXCAVATED LAGOONS	B13-001	0.079
	B11-001	0.161

AR300904

detectable to 130,000 ug/kg. These results are consistent with the use of this area to store finished products. Drippage from finished products could result in locally high concentrations of contaminants.

The surface soil samples from the vicinity of the freshwater pond contained non-detectable to low part per million levels of contaminants. These samples were collected to the north and west of the pond. Due to their proximity to the excavated lagoon and the topographic slope of the area, it is probable that soil contamination levels in surface soils to the east of the pond would be similar to those in the excavated lagoons area.

The surface soils in the process area were covered with a clay cap during the Immediate Removal Action. Surface soil samples collected in this area were taken to a depth of approximately six inches below this clay cap. The soils below the cap were found to contain up to 1,290 ug/kg of PNAs.

No organic contaminants were detected in surface soil samples from the spray irrigation area.

As shown in Table 4-7, the 2,3,7,8-tetrachloro dibenzodioxin (TCDD) toxicity equivalent factors (TEF) reported for surface soils are below 1.0 ug/kg. Toxicity equivalent factors relate the concentration of all chlorinated dioxin and furan congeners to the equivalent toxicity as 2,3,7,8-TCDD. Each congener is "weighted" based on its specific toxicity and the results of all congeners are summed to yield the TEF.

A more complete discussion of the calculation and application of TEFs may be found in the January 14, 1986 Federal Register. The dioxin/furan data are consistent with areas where concentrated

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waste was disposed. The areas with positive TEF values were the land treatment area, the process area, the northeast tank area, and the excavated lagoons area. The TEF values in these areas ranged from 0.006 to 0.765 ug/kg. The soil samples collected from a stained area beside Tank No. 10 had TEFs of 0.036 and 0.017 ug/kg in duplicate analyses. The soil sample collected at boring location SS-06 just off-site from the northeast tank area had a TEF of 0.000 ug/kg (i.e., below detection limits).

Table 4-8 summarizes the relative percentages of the various chlorinated dibenzodioxin and dibenzofuran congeners.

The dioxin congeners found in surface soil samples were the more highly chlorinated, and relatively less toxic, forms. Although hepta-and-octa-chlorinated dibenzodioxins were detected in all surface soil samples, hexa chlorinated dibenzodioxins were found in only seven of 13 surface soil samples. The surface soil sample from boring B-09 contained 0.3 ug/kg of 2,3,7,8 x pentachloro dibenzodioxin (PCDD) but no other PCDDs were detected in surface soil samples. No tetrachlorinated dibenzodioxins were detected in the surface soil samples.

4.4.3 SUBSURFACE SOILS

4.4.3.1 General

The subsurface soils are those soils encountered below the surface soils. The subsurface soils were described and characterized for geotechnical properties to an elevation of approximately el. 108 feet MSL.

The investigation of the subsurface soils was conducted to determine the nature and extent of contamination, to develop detailed stratigraphic information showing the orientation and

TABLE 4-8

RELATIVE PERCENTAGES OF CHLORINATED DIBENZO-
DIOXIN AND DIBENZOFURAN CONGENERS IN SURFACE SOILS

<u>Congener</u>	<u>% of Dioxins</u>	<u>% of Furans</u>
Tetra-	0	0.7
Penta-	<0.1	0.7
Hexa-	0.9	6.7
Hepta-	15.3	46.1
Octa-	83.8	45.8

thickness of the various soil types below the site and to obtain geotechnical data to evaluate soil conditions, permeability, and remedial options.

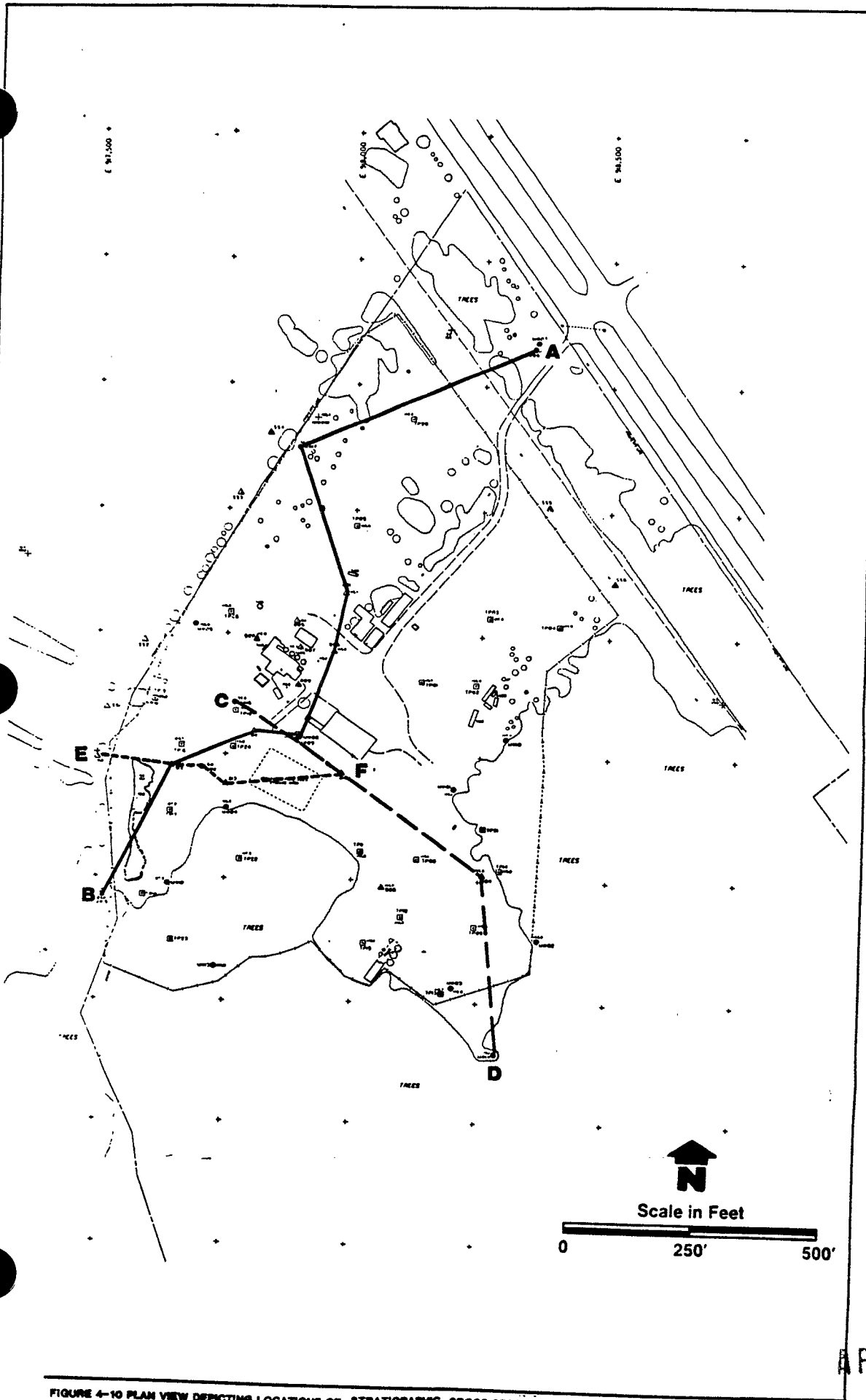
4.4.3.2 Soils Encountered

Subsurface soils were characterized by the installation of soil borings and construction of test pits. Figures 4-11, 4-12 and 4-13 depict generalized cross-sections of the soils along the three transects identified in Figure 4-10.

Soil boring data indicates that the stratigraphy at the site generally consists of between 10 and 38 feet of predominantly silty sand to sand deposits overlying a clay and silt layer. Interbeds of clay and silt were encountered in the silty sand to sand unit. These clay and silt units range in thickness from less than one foot to approximately seven feet. Clay and silt interbeds, and silty and clayey sand deposits were most abundant in the land treatment area.

As shown in Figure 4-11 through 4-13, the lower-most clay and silt layer appears to be extensive across the site. The clay and silt layer was encountered in all deeper borings at elevations from 111.9 feet at B01 to 119.6 feet at MW-14. Figure 4-14 shows an elevation contour map of the top of the clay and silt layer.

Since none of the soil borings penetrated this layer, the thickness of the unit could not be defined, but is at least seven feet thick at MW-06. However, the lower-most clay and silt layer encountered in the soil boring program correlates to a blue clay layer reported in the drilling log from the on-site production well. The blue clay is approximately 20 feet thick and occurs at depths from 30 to 50 feet below ground surface.



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FIGURE 4-10 PLAN VIEW DEPICTING LOCATIONS OF STRATIGRAPHIC CROSS SECTIONS REPRESENTED IN FIGURES 4-11, 4-12, AND 4-13

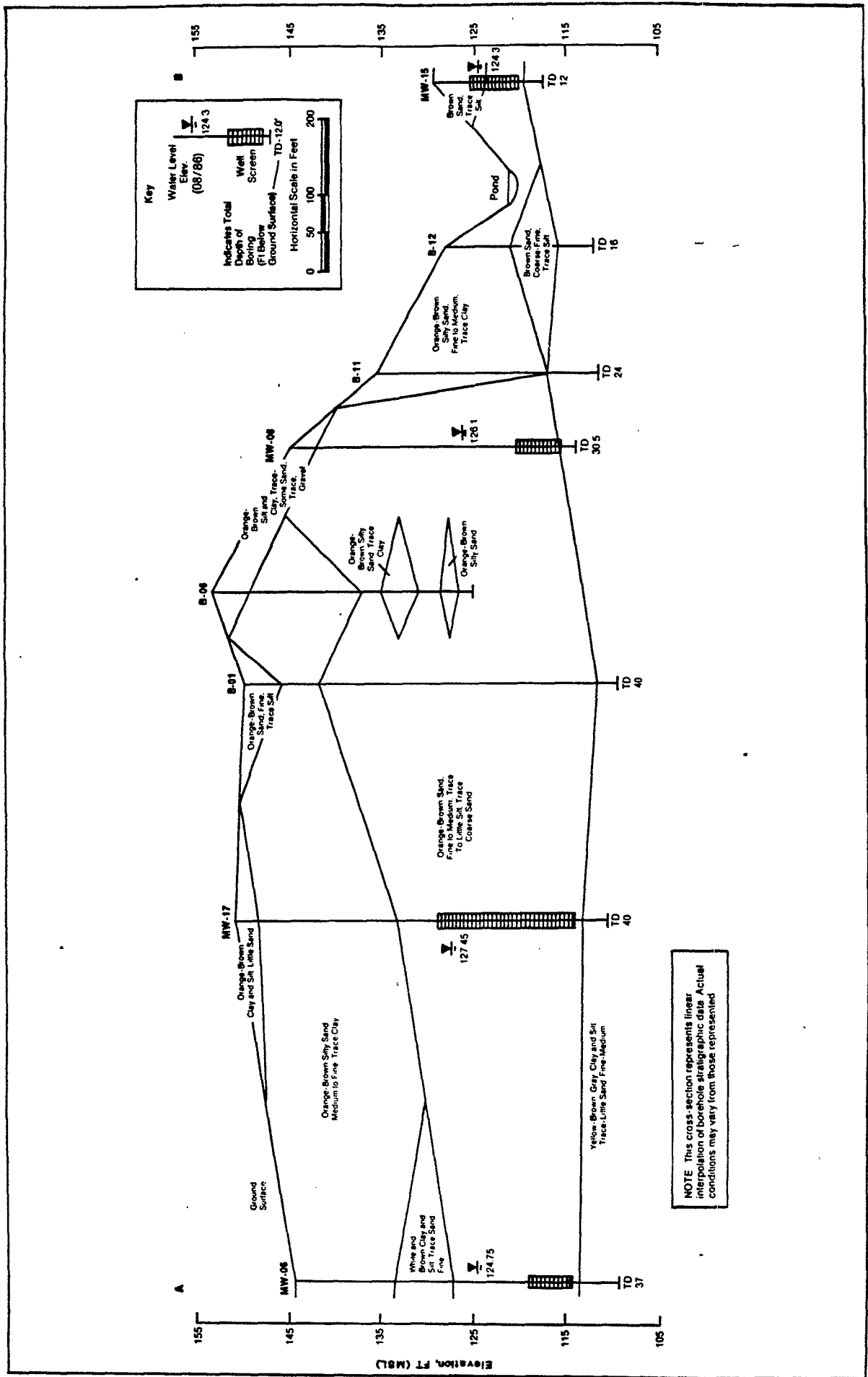


FIGURE 4-11 GENERALIZED STRATIGRAPHIC CROSS SECTION A-B

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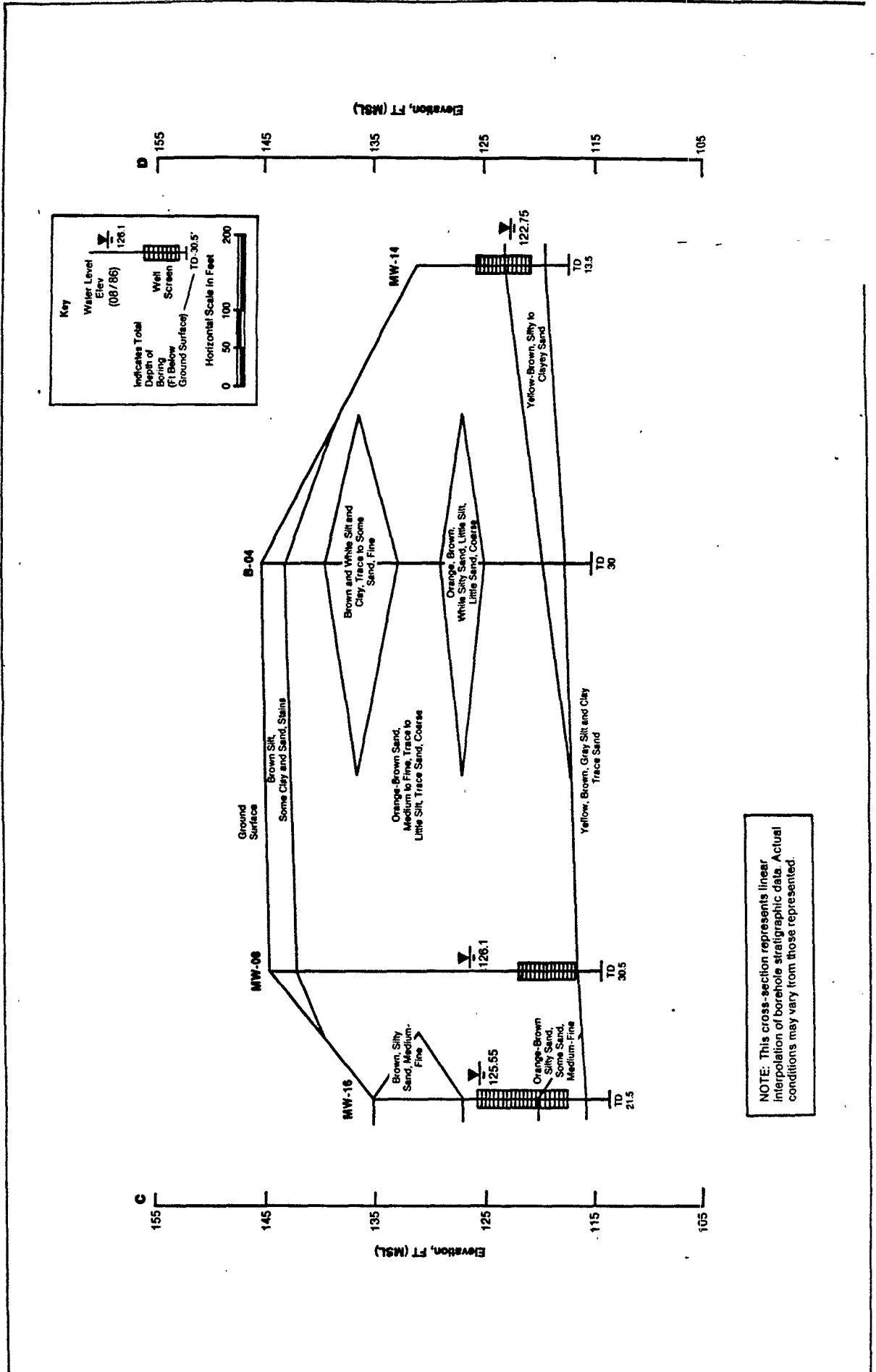


FIGURE 4-12 GENERALIZED STRATIGRAPHIC CROSS SECTION C-D

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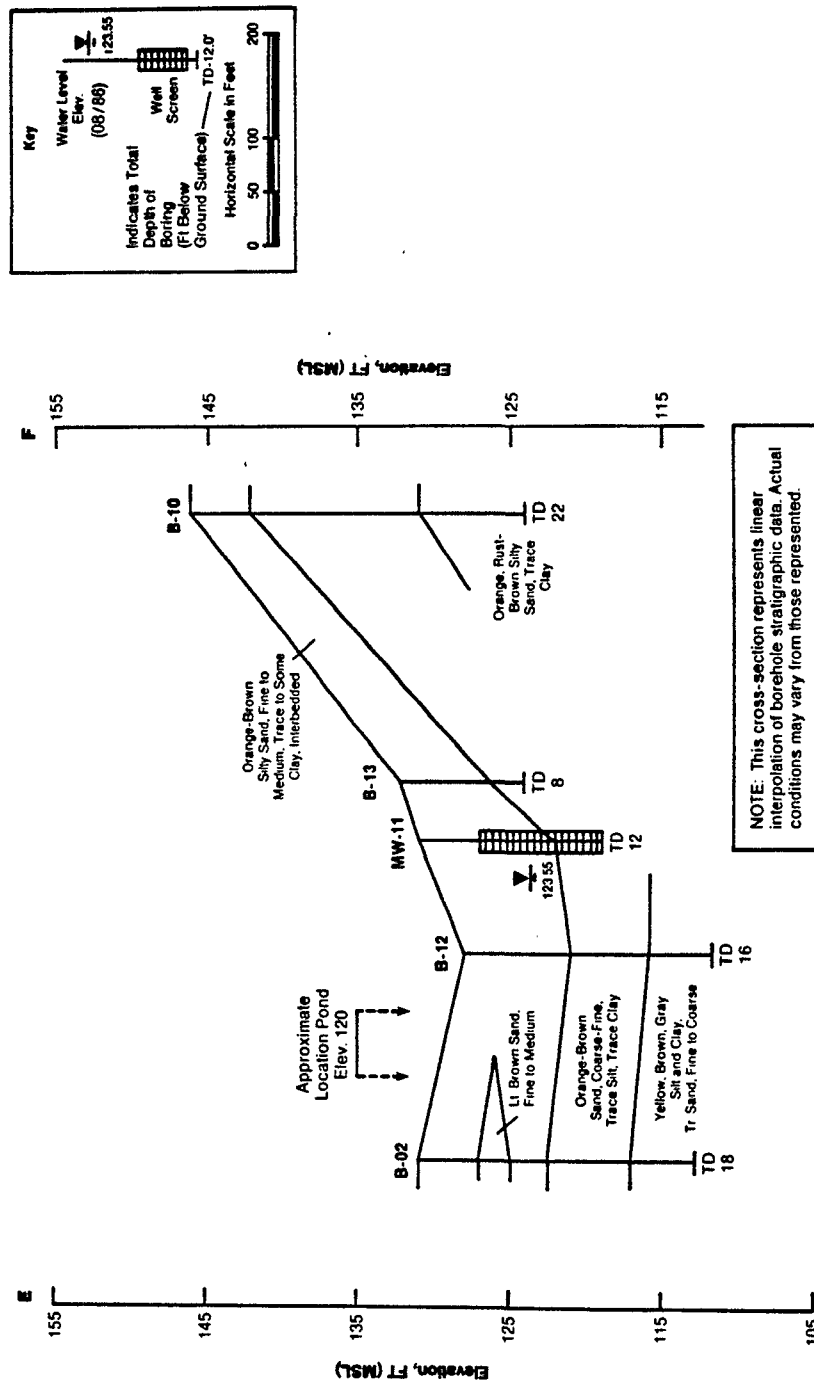


FIGURE 4-13 GENERALIZED STRATIGRAPHIC CROSS SECTION E-F

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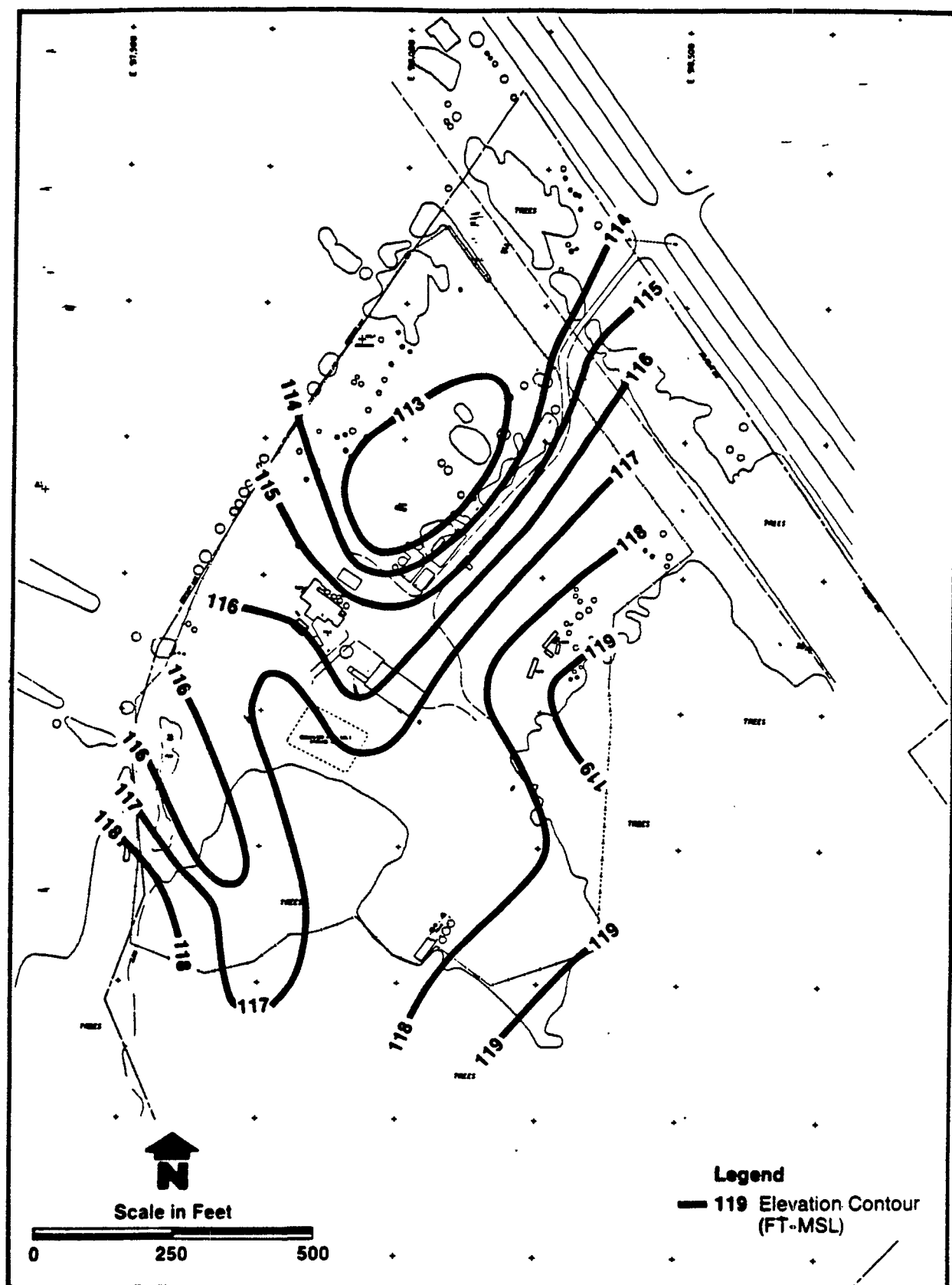


FIGURE 4-14 ELEVATION CONTOUR MAP OF THE TOP OF THE CLAY & SILT LAYER

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4.4.3.3 Geotechnical Testing Results

The results of the geotechnical analyses are presented in Table 4-9. The laboratory data is provided in Appendix G.

The permeability data indicate that the silty to clayey fine to medium grain sands have a low permeability, with coefficients of permeability (k) of 9.7×10^{-6} cm/sec and 2.7×10^{-5} cm/sec. The Atterberg Limits tests on these sands are consistent with USCS classifications of SM to SC. The particle size distribution on these sands can be summarized as follows:

sands content:	65-92%
silt content:	3-10%
clay content:	3-25%

This distribution would typically be classified as fine to medium grain sand with little to trace silt or clay (SP, SM, SW, or SC).

The shear strength result for these silty to clayey fine to medium grain sands was 0.05 tons/ft^2 , indicating extremely low cohesion properties. The specific gravity result of 2.69 is typical of most soils (average value 2.709).

The coefficients of permeability (k) for the clayey soil layers are relatively low, with values of 3.6×10^{-8} cm/sec and 1.9×10^{-6} cm/sec. The Atterberg Limits tests on these soils are consistent with USCS classification of ML. The particle size distribution of the clayey silts was:

sands content:	2-20%
silt content:	40-55%
clay content:	35-43%

TABLE 4-9

SUMMARY OF GEOTECHNICAL RESULTS FOR AT PHASE II SOIL SAMPLES

SAMPLE NUMBER	DEPTH INTERVAL (FEET)	SHEAR STRENGTH (TONS/SG.FT)	LIQUID PLASTICITY LIMIT (LL)	PLASTICITY LIMIT (PL)	USCS DESIGNATION	ISABELL SAND	SILT	CLAY	WATER CONTENT (%)	DEGREE OF SATURATION (%)	CONDUCTIVITY (μ sec/cm)
ISO-B02-003	4.0-6.0								5.0		
ISO-B02-006/007	10.0-14.0		18	5	SC-SM	0	85	4	11	82.0	9.7E-06
ISO-B02-007	12.0-14.0								24.6		
ISO-B02-008	14.0-16.0								31.7		
ISO-B02-009	16.0-18.0	0.3	2.67		ML	0	15	55	37.8		
ISO-B03-003	8.0-10.0								8.0		
ISO-B03-010	18.0-20.0								16.6		
ISO-B04-004	4.0-8.0								14.4		
ISO-B04-011/013	20.0-26.0		(2)	(2)	SP-SC	0	92	1	7	115.0	2.7E-05
ISO-B04-015	28.0-30.0		40	13	ML	0	10	55	34.4	164.0	3.4E-08
ISO-B05-006	10.0-12.0								10.8		
ISO-B06-007	12.0-14.0								10.8		
ISO-B06-014	26.0-28.0								18.7		
ISO-B07-009	16.0-18.0								9.6		
ISO-B07-014	26.0-28.0								19.9		
ISO-B07-019	36.0-38.0								33.0		
ISO-B08-005	8.0-10.0								15.1		
ISO-B08-012	22.0-24.0								21.4		
ISO-B09-008	14.0-16.0								6.7		
ISO-B09-013	24.0-26.0								7		
ISO-B10-004	6.0-8.0								12.9		
ISO-B10-011	20.0-22.0								20.2		
ISO-B11-002	2.0-4.0								11.9		
ISO-B11-005	8.0-10.0								19.1		
ISO-B11-006/009	10.0-18.0				SM-SC	12	78	3	7	10.3	87.0
ISO-B11-011	20.0-22.0								19.2		
ISO-B11-012	22.0-24.0	0.6	2.79		ML	0	2	55	52.2	249.0	
ISO-B12-002	2.0-4.0								13.8		
ISO-B12-004	4.0-8.0	0.05	32	14	SC	0	45	10	25	81.0	(2)
ISO-B12-006	10.0-12.0								18.7		
ISO-B12-007	12.0-14.0								35.0		
ISO-B12-008	14.0-16.0		41	14	CL-ML	0	20	40	36.1	157.0	1.9E-06
ISO-B13-002	2.0-4.0								13.9		
ISO-B13-004	6.0-8.0								22.4		
ISO-M17-002	4.5-6.5								14.2		
ISO-M17-008	29.5-31.5								17.5		
ISO-M17-010	38.0-40.0								61.1		

(1) Degree of saturation for samples with hydraulic conductivity results based on final dry densities.

(2) Non plastic, USCS Designation based upon visual observation.

(3) Collapsed during test.

AR300915

The distribution would typically be classified as clayey silts with trace to little sand (ML).

The shear strength results for these clayey silts ranged from 0.3 to 0.6 tons/ft², indicative of a soft to medium stiff soil. The specific gravity results of 2.67 and 2.70 are typical of most soils. The moisture content results indicate that this clayey silt layer is under saturated conditions.

4.4.3.4 Chemical Analytical Results

The analytical results for subsurface soils (greater than 2 feet below grade) are summarized by area in Table 4-10. The areas described were depicted previously in Figure 4-9. The most frequently identified organic compounds are listed in Table 4-11.

Except in those areas with a long history of waste disposal (i.e., the process area and the excavated lagoons areas), the organic contaminants are essentially confined to the upper ten feet of soil. The exception for the process area and excavated lagoons area is consistent with the presence of the black stain encountered in the saturated soils just above the clay layer in these two areas.

The presence of high concentrations of contaminants in the 2-10 foot interval in the area of the freshwater pond is probably an expression of the shallow depth to the clay and the presence of the staining in the saturated soils in this area. A sample taken at a depth interval of 8 to 10 feet in boring B12 included this stained soil and contained over 3,200,000 ug/kg of PNAs. Additionally, the sample was found to contain over 52,000 ug/kg of VOCs and greater than 36,000 ug/kg of PCP

It is instructive to note that the commonly identified organics include more mobile PNAs (naphthalene, 2-methylnaphthalene) and

TABLE 4-10
SUMMARY OF ANALYTICAL RESULTS OF SUBSURFACE SOILS BY AREA

DEPTH BELOW GROUND SURFACE	OTHER ORGANIC BASES/ ACID NEUTRAL EXTRACT-EXTRACT- PCP PAHs WPCS (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg) (mg/kg)										FIELD SCREENING FOR PAHs (mg/kg)		OIL AND GREASE (mg/kg)		TOTAL ORGANIC CARBON (mg/kg)		ALUMINUM (mg/kg)		CARBON (mg/kg)		COPPER (mg/kg)		IRON (mg/kg)		LEAD (mg/kg)		MERCURY (mg/kg)		ZINC (mg/kg)	
	WCS (mg/kg)	PCP (mg/kg)	PAHs (mg/kg)	WPCS (mg/kg)	EXTRACT- ABLES (mg/kg)	ACID EXTRACT- ABLES (mg/kg)	FIELD SCREENING FOR PAHs (mg/kg)	OIL AND GREASE (mg/kg)	TOTAL ORGANIC CARBON (mg/kg)	ALUMINUM (mg/kg)	CARBON (mg/kg)	COPPER (mg/kg)	IRON (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)														
Upper Site	2-10'	ND-3	ND	ND	ND	ND	ND	(50,300)	647,000	1,120	ND	5-5.6	529,10,900	ND	ND 0.1	26.5														
	10'+	ND	81	ND	ND	ND	ND	---	---	4,200	7	5	5,270	2.8	ND	2														
DE Tank Area	2-10'	ND	ND	ND	ND	ND	ND	---	---	12,500	6.9	5.5	9,350	ND	0.1	4.7														
	10'+	---	---	---	---	---	ND	---	---	---	---	---	---	---	---	---														
Land Test Area	2-10'	ND	ND	ND	ND	ND	ND	---	---	4,090	ND-11	2.9-6.7	2,590	ND 50	ND 0.15	2.179														
		9,700	4,610	750	220	190	23,000,000	---	---	15,000	---	---	17,000	---	---	---														
	10'+	ND	ND	ND	ND	ND	ND	---	---	---	---	---	---	---	---	---														
Specy Irrig Area	2-10'	ND	ND	ND	ND	ND	ND	---	---	6,160	ND	4.6	22,600	5.6	ND	5.6														
	10'+	ND	ND	ND	ND	ND	ND	---	---	8,100	9.5	4.6	16,500	5	0.075	5.6														
Freemaster Pond Area	12-10'	ND	ND	ND	ND	ND	ND	(50,500)	657,000	9,590	ND-19	5.6	6,570	ND	ND 0.1	29.5.8														
		70,000	13,700,000	76,000	3,000	650,000	150,000,000	---	---	9,100	---	---	29,900	---	---	---														
Excavated Lagoon Area	2-10'	ND	ND	ND	ND	ND	ND	(30,500)	1,900,000	14,000	ND-16	ND-7.2	5,410	ND	ND 0.1	2.17														
		561,000	3,900,000	90,000	59	620,000	45,000,000	5,560,000	4,850,000	23,300	---	---	20,600	---	---	---														
	10'+	ND	3,005	1,700	140	320	53,000	---	---	2,450	ND	5	3,200	1.8	ND	2														
Process Area	2-10'	ND	ND	ND	ND	ND	ND	(50,600)	1,270,000	3,550	10-19	4.5-7.1	6,600	ND 9.6	ND 0.15	8.50														
		17,600	2,530,000		37	640,000	42,000	---	---	4,000	---	---	18,600	---	---	---														
	10'+	ND	ND	ND	ND	ND	ND	(30,500)	29,900	15,760	ND	3.3.8	1,970	ND	ND 0.1	5.5.4														
								41,500	626,000	15,900	---	---	9,750	---	---	---														

Note: All results reported on a dry weight basis.

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TABLE 4-11

ORGANIC COMPOUNDS MOST FREQUENTLY
IDENTIFIED IN SUBSURFACE SOIL SAMPLES

<u>Volatile Organic Compounds</u>	<u>Polynuclear Aromatics</u>	<u>Other Acid Extractables</u>	<u>Other Base/Neutral Extractables</u>
Toluene	Naphthalene	Phenol	Dibenzofuran
Ethylbenzene	2-Methylnaphthalene	2,4-dimethylphenol	
Styrene	Acenaphthene		
Xylenes	Fluorene		
	Phenanthrene		
	Fluoranthene		
	Pyrene		
	Pyrene (k) Fluoranthene		

acid extractables (phenol, 2-methylphenol, 2,4-dimethylphenol) found in ground water samples but not commonly seen in surface soil samples. These compounds appear to be moving through the soil to the ground water at a faster rate than the less mobile PNAs.

4.4.4 SUMMARY OF SOIL INVESTIGATION

Approximations of volumes of soils requiring remediation were developed based on the PNA screening and conventional analytical data for PNAs. Because no risk assessment has been funded at this time, the volume estimates were prepared for a range of total PNA concentrations (specifically 5, 10 and 100 ppm). The volume estimates can be modified based on specific action levels developed in the risk assessment. These volumes can be used in evaluating costs associated with various remedial options.

The soil volume estimates are based primarily upon the results of the PNA screening analysis. As the PNA screening analysis provides an order of magnitude, the use of UV screening results to estimate actual PNA concentrations in soils is justified. The UV screening ranges which were used as representative of the total PNA values were:

<u>Total PNA Concentration</u>	<u>PNA Screening Result</u>
≥ 5	50-99
≥ 10	100-999
≥ 100	1000 +

A more detailed discussion of the relationship between PNA screening results and total PNA concentrations in soils is provided in Appendix H.

The approximate soil remediation volumes, which assume that the 1,400 yd³ of soil excavated during the EPA removal action will require remediation, are shown in Table 4-12. The approximate volume of soils encountered under saturated conditions are also listed. The high moisture content of these soils will impact excavation and treatment.

4.5 TANKS, RETORTS, AND BUILDINGS INVENTORY

4.5.1 BUILDINGS

Three buildings and four sheds are located on site as depicted in Figure 4-15.

Building 1 served as the office for the wood treating plant and is now the office for the retail lumber business operated on-site.

Building 2 is an abandoned storage building. This building was used to store waste wood, and the debris which was removed from the process area prior to construction of the clay cap during the Immediate Removal Action.

Building 3 was the processing building for the wood treatment plant. Two large retorts dominate the inside of this building. The boiler room is located in the southwest corner of the process building. A tank found in this room was determined to be used as a make-up tank for boiler water pretreatment. Two drums were found in this room which appeared to contain boiler treatment chemicals. Building 3 also houses the electric panel for the property.

Sheds 1 and 2 are actually covered extensions from Building 1 (the office). These extensions are used to store crab traps which are constructed and sold at the site.

TABLE 4-12
APPROXIMATE VOLUME OF SOILS REQUIRING TREATMENT
AT VARIOUS TOTAL PNA CONCENTRATIONS

ACTION LEVEL <u>TOTAL PNAs (mg/kg)</u>	TOTAL VOLUME OF <u>SOIL (yd³)</u> ⁽¹⁾	VOLUME OF SATURATED <u>SOIL (yd³)</u>
5	83,000	18,000
10	60,000	12,000
100	43,000	9,500

(1) Includes saturated and unsaturated soils.

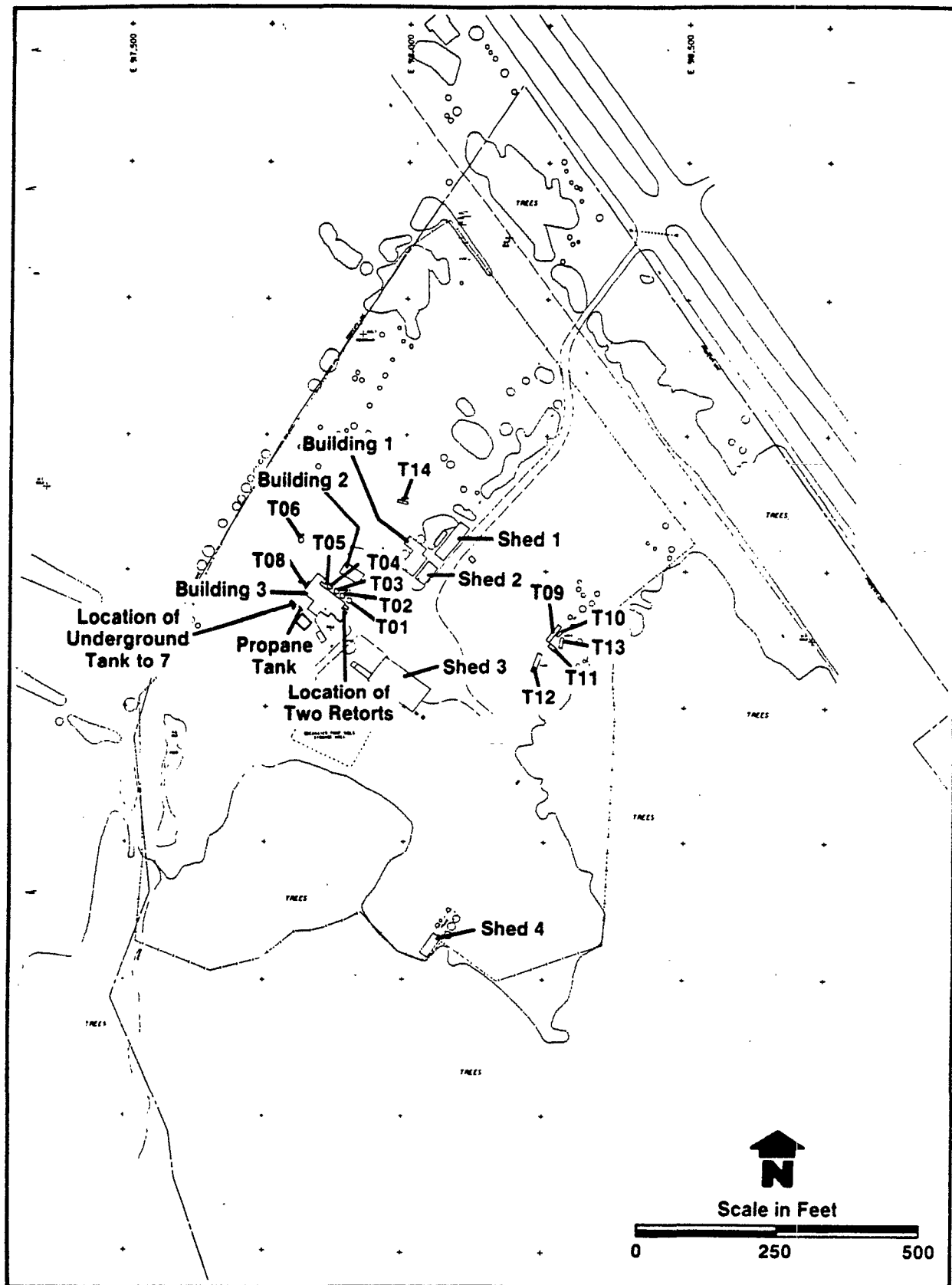


FIGURE 4-15 LOCATIONS OF ON-SITE BUILDINGS

AR300922

Shed 3 houses a large circular saw and is used by the retail lumber company as a wood storage facility. The shed is open to the driveway on its northern side.

Shed 4 was used as a maintenance shop while the plant was active. Presently, the shed is dilapidated and abandoned.

No sampling of the buildings was conducted during the remedial investigation.

4.5.2 TANKS AND RETORTS

Excluding a propane storage tank and the boiler treatment water make-up tank, 14 tanks and two retorts were found on-site. The locations of these tanks and retorts were depicted in Figure 3-7. Table 4-13 summarizes the analytical results for the tank samples.

Tanks 2, 8, and 11 were found to be empty. Tanks 2 and 11 were used for raw materials storage. Tank 8 was used to control the vacuum on the two retorts.

Both retorts were found to be empty. Although Retort 1 had some residual oils which coated the weighted rope used to measure its contents, the quantity of residue was not sufficient to sample.

Analysis of the materials in Tank 7 indicated 160 ug/kg of VOCs and was believed to be used as a fuel oil storage tank. The results of analyses of the materials in Tank 6 for volatile and semivolatile organics and lead, chromium, and mercury were below the method detection limits.

TABLE 4-13

SUMMARY OF TANK SAMPLING AND ANALYSIS PROGRAM

TANK NUMBER	ORIGINAL USE	MATRIX DESCRIPTION	CONCENTRATION OF ANALYTES (PPM EXCEPT DIOXINS)									
			TANK VOLUME	MATERIAL VOLUME	VOLATILE	TOTAL PHAS	OTHER BASE	PCP	DIOXINS (PPB)	OTHER ACID	ALUMINUM & IRON	ZINC & COPPER
1	RAW MATERIALS	LIQUID	34,000	2,100	1.02	191.	18.0	ND	0.00	492.0	ND	0.26
2	RAW MATERIALS		34,000	EMPTY								
3	RAW MATERIALS	LIQUID	19,000	3,700					22.7			
4	RAW MATERIALS	LIQUID	19,000	5,300					28.3			
COMPOSITE OF 3 & 4					55.6	84.8	ND	140.	ND	46.0	ND	ND
5	PROCESS MAKE UP TANK	LIQUID	2,600	1,600	ND	ND	ND	ND	57.9	144,000	64,200	121.
6	WATER	LIQUID	SEE NOTES	SEE NOTES	ND	ND	ND	ND	ND	72,200	926.	ND
7	FUEL OIL	LIQUID	SEE NOTES	SEE NOTES	0.16	ND	ND	ND	0.00	34,900	47.	8.
8	VACUUM CONTROL	N/A	N/A	EMPTY								
9	RAW MATERIALS	SOLID	21,000	920	36.6	1,300	ND	21,000	8.48	27,100	174.	90.
10	RAW MATERIALS	SOLID	1,960	25								
11	RAW MATERIALS			EMPTY								
12	RAW MATERIALS	SOLID	21,000	415	19.7	70,300	ND	ND	8.68	1,240.	ND	2.7
13	RAW MATERIALS	LIQUID	5,800	10	0.33	ND	197	ND	0.00	2,398.	58.8	57.0
14	RAW MATERIALS	LIQUID	5,800	26	0.39	ND	ND	ND	0.00	58,600	849.	507.

NOTES

o TANK 6 MAY BE DUFFED, VOLUME AND CONTENTS UNDETERMINED, ASSUMED APPROXIMATELY 20,000 GALLONS.

o TANK 7 UNDERGROUND, VOLUME UNDETERMINED.

o TANK 10 WAS NOT SAMPLED DUE TO SMALL OPENING AND LIMITED AMOUNT OF MATERIAL.

o DIOXINS EXPRESSED AS TOXICITY EQUIVALENT FACTOR RELATED TO 2,3,7,8-TCDD. ALL CHLORINATED DIOXINS AND FURANS DETECTED WERE ASSUMED TO BE 2,3,7,8- SUBSTITUTED.

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The dioxin results provided in Table 4-13 represent the toxicity equivalent factor (TEF) for the samples analyzed. For the tank samples, the TEF was calculated based on the quantities of the various congeners detected in each sample. Table 4-14 summarizes the relative percentages of the various chlorinated dibenzodioxin and dibenzofuran congeners. Like the soil results, no tetra-chlorinated dibenzodioxins were detected in the tank samples.

Based on the levels of dioxins found in raw materials tanks, it should be assumed that the retorts are also contaminated with dioxins.

In summary, the following volume estimates can be made:

- A total of approximately 11,960 gallons of dioxin contaminated wastes are present on-site Tanks 3, 4, 5, 9, 10 and 12. Due to the similarity of appearance to the material in Tanks 9 and 12, the waste in Tank 10 (which was not sampled) is also assumed to contain dioxins.
- A total of approximately 2,140 gallons of tank wastes do not contain dioxins. Of these 2140 gallons, all contained total volatile organic compound concentrations greater than 300 ppb and 2,100 gallons contained total PNA concentration 191,000 ppb.

These volumes do not include volumes of materials in Tank 7 (the underground fuel oil tank) or Tank 6 (the water tank).

4.6 SURFACE WATER AND SEDIMENTS

The analytical results for surface water and sediment samples are summarized in Table 4-15. The sample locations are depicted in Figure 4-16.

In the sediment samples collected along the west tributary, total PNA concentrations in the tens of parts per million were

TABLE 4-14

RELATIVE PERCENTAGES OF
CHLORINATED DIBENZODIOXIN AND
DIBENZOFURAN CONGENERS IN TANK SAMPLES

<u>Congener</u>	<u>% in Dioxin</u>	<u>% in Furan</u>
Tetra-	0	<0.1
Penta-	0	0.2
Hexa-	1.2	4.4
Hepta	20.2	29.1
Octa-	78.6	66.4

TABLE 4-15

SUMMARY OF SURFACE WATER AND SEDIMENT ANALYTICAL RESULTS

AREA	SAMPLE STATIONS	VOLATILE ORGANICS (ppb)	PMS (ppb)	POP (ppb)	EXTRACT-ABLES (ppb)	OTHER ACID EXTRACT-ABLES/NEUTRAL	FIELD SCREENING FOR PMS (ppb)	OIL AND GREASE (ppb)	TOTAL ORGANIC CARBON (ppb)	ALUMINUM (ppb)	CHLORIDE (ppb)	COPPER (ppb)	IRON (ppb)	LEAD (ppb)	MERCURY (ppb)	ZINC (ppb)
ON SITE																
PC1, SC1, 100																
Sediment	07 197	4,750-85,300	10	10	630-3,000	10-4,600,000	10-4,600,000	(31,700-66,100)	916,000-4,530,000	2,960-4,530	3,355.9	10	6,100-89,300	4.9-7.7	10	0.2-12
	20	230	120	136	15	—	—	—	14,600	10	10	10	6.13	10	10	0.009
WSE INTIMIDARY																
no pond																
Surface Water	10-5	51,900-53,600	10	10	1,400-2,100	10-8,200,000	36,500-93,000	—	1,220,000-3,670,000	2,100-2,860	4.3-4.9	10	2,630-3,000	2.6-3.5	10	7.2-12
	10	10-54	10-42	10-47	10-10	—	—	—	9,900-10,100	10-8,660	10	10	2.40-2.52	10	0.0053	0.004-0.117
100 to 117																
Sediment	10	1,400(1)	16,400	10-240	10	27,000-320,000	(31,600-132,500)	—	1,000,000-1,690,000	1,000-2,590	2.1-4.1	10	1,420-4,320	2-3.0	10	10-5
	10	10	10	10	10	—	—	—	6,100-20,000	10	10	10	2.0-4.25	10	0.0053	10-0.064
LAST INTIMIDARY																
100 to 100																
Sediment	100	1,000	100	100	100	10-32,000	(30,700-255,000)	—	2,000,000-3,200,000	640-7,600	10-13	10-6.4	340-7,000	1.9-100	10-0.2	10-20
	100	100	100	100-4	100	—	—	—	2,100-10,200	10-8,305	10-0.323	10	0.43-1.26	10	10	0.004-0.033
100 ft from fence																
Sediment	100	1,000	100	100	100	30,000-66,000	(32,300)	—	916,000	6,500	7.7	10	21,700	14	10	14
	100	100	100	100	100	—	—	—	—	—	—	—	—	—	—	—
AT CONFINEMENT																
of 10 miles																
1900 ft from pond																
Sediment	100	10,000	100	100	170	10-100,000	(32,300)	—	1,000,000	4,000	7.1	10	32,600	11	10	10
	100	77	100	100	13	—	—	—	10,000	0.094	10	10	41.4	10	10	10
100 to 100 (100)																
4450 1/25 ft from pond																
Sediment	100	10-41	100	100	100	10-430,000	(31,700-135,300)	—	1,670-11,700,000	1,600-19,200	3.8-20	10-9.2	2,410-44,000	5.6-34	10	10-44
	100	100	100	100	100	—	—	—	7,300-17,200	10-5.31	10	10	6,07-29.1	10-0.012	10	10-0.025
100 ft from pond																
Sediment	100	100	100	100	100	10-77,000	—	—	—	—	—	—	—	—	—	—
	100	100	100	100	100	—	—	—	—	—	—	—	—	—	—	—

(1) 100 ft sample was collected from a 10" depth interval

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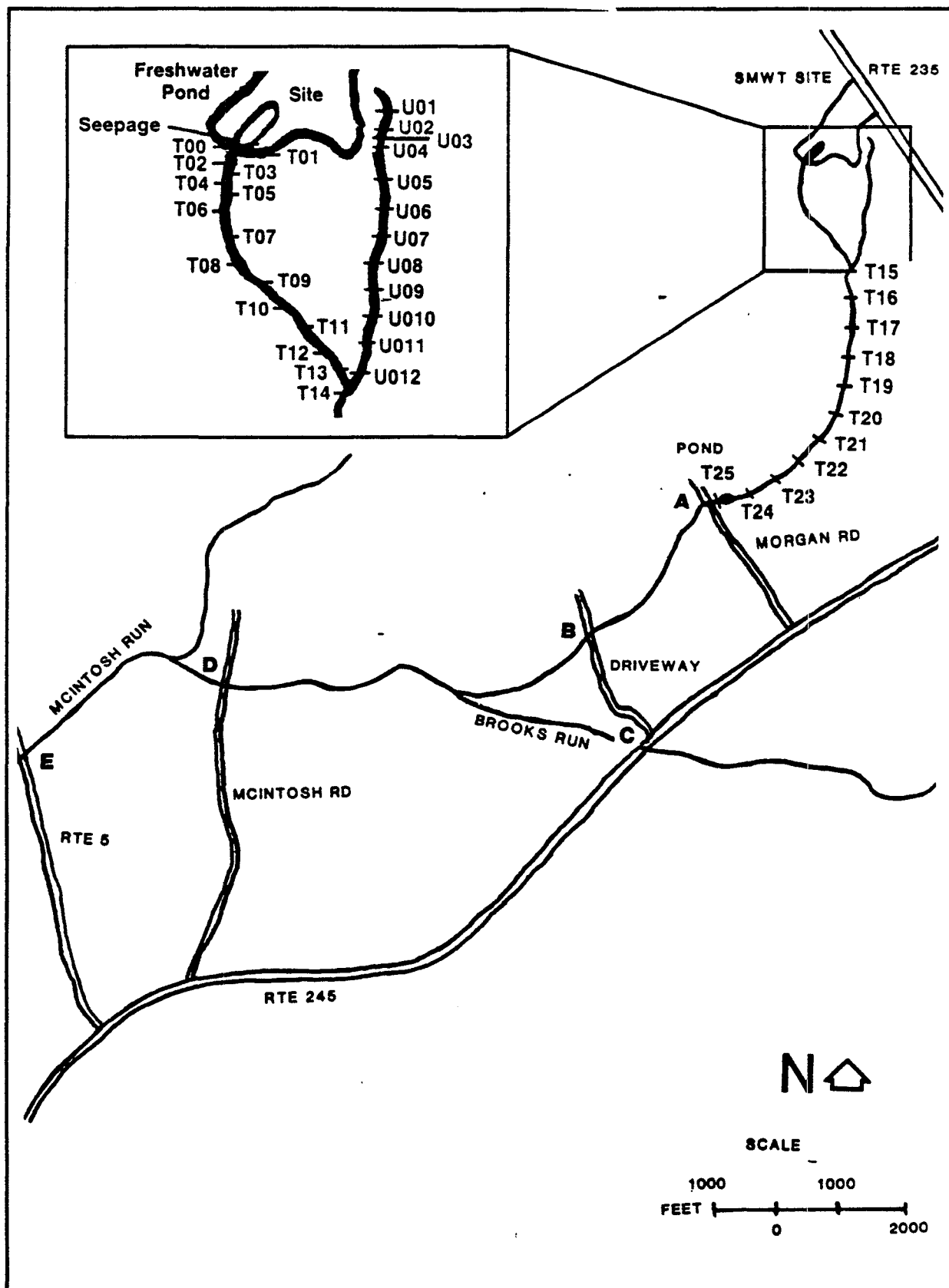


FIGURE 4-16 SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

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encountered up to 1,900 feet downstream of the freshwater pond, at the confluence of the east and west tributaries. Surface water concentrations of organic contaminants are in the tens to hundreds of parts per billion along this section of stream.

Along the east tributary, contaminant concentrations in sediments ranged from non-detectable to approximately two parts per million in a sample collected near the confluence of the east and west tributary. Surface water contaminants range from non-detectable to parts per billion (phenol at 4 ug/L).

At distances between 4,450 and 7,125 feet from the freshwater pond, sediment contamination ranges from non-detectable to 41 ug/kg of PNAs and surface water contamination was not detected. Table 4-16 provides a summary of the most frequently identified organic contaminants in surface water and sediments. The contaminants detected in the surface water samples are similar to those compounds found in ground water. Sediment results are similar to the results obtained for the surface soils. This data supports two pathways of contaminant migration at the site. The transport of contaminants from surface soils to stream sediments through surface runoff/erosion is indicated by this data and the low cohesive strength of the site soils. Additionally, the direct discharge of contaminated ground water into the freshwater pond is supported by the similar contaminants in both media and visual observations of seeps along the pond bank.

The results of 0-6" and 6-12" sediment samples analyzed by the UV screening method were compared. This comparison indicates that samples from the 0-6" and 6-12" sample intervals typically contain PNA concentrations within the same order-of-magnitude. This is consistent with the long-term deposition of sediments carrying contaminants from upstream sources and does not indicate significant changes in contaminant concentration over time.

TABLE 4-16

MOST FREQUENTLY IDENTIFIED ORGANIC COMPOUNDS
IN SURFACE WATER AND SEDIMENTS

VOLATILE ORGANIC COMPOUNDS		PNA's		OTHER ACID EXTRACTABLES		OTHER BASE/NEUTRAL EXTRACTABLES	
SURFACE WATER	SEDIMENTS	SURFACE WATER	SEDIMENTS	SURFACE WATER	SEDIMENTS	SURFACE WATER	SEDIMENTS
Benzene	Benzene	Fluorene	Fluorene	Phenol	--	Dibenzo- furan	Dibenzo- furan
Toluene	Toluene	Fluoranthene	Phenanthrene	2,4-di- methyl- phenol			
Ethylbenzene	Ethylbenzene	Fluoranthene					
Styrene		Pyrene					
Xylenes		Benzo(a)- Anthracene					
Pyrene		Benzo(k) Fluoranthene					
		Benzo(a)- Pyrene					

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The results of water quality parameter analyses performed on surface water samples indicated a range of chemical oxygen demand concentrations from 10 to 82 mg/L and a range of five-day biological oxygen demand concentrations from 4 to 31 ug/L. Nitrogen concentration ranged from 0.19 to 7.0 mg/L for total Kjeldhal nitrogen and from 1.6 to 10.0 mg/L for nitrate/nitrite nitrogen. Phosphorous concentrations ranged from 0.37 to 0.74 mg/L.

Although dioxins and furans were detected in surface waters and sediments, toxicity equivalent factors were at or below 0.010 ppb. The presence of dioxins in surface waters is probably the result of trace amounts of sediments (suspended solids) associated with these unfiltered water samples. The dioxin and furan data is summarized in Table 4-17. Table 4-18 details the relative percentages of the various dioxin and congeners identified in surface water and sediments. No tetra- or penta-chlorinated dibenzodioxins were detected in surface water or sediment samples.

TABLE 4-17

SUMMARY OF DIOXIN/FURAN RESULTS FOR SURFACE WATER AND SEDIMENT SAMPLES

LOCATION	SAMPLE NUMBER	SAMPLE MATRIX	DEPTH INTERVAL	TOTAL TEF (ppb)
ON-SITE	PC2-001	ISW	N/A	0.000
	PC2-002	ISW	N/A	0.000
	PC1-001	ISED	0-6"	0.009
	SC1-010	ISED	0-6"	0.001
WEST TRIBUTARY	TO1-010	ISED	0-6"	0.008
	TO4-010	ISED	0-6"	0.003
	TO7-010	ISED	0-6"	0.002
	TI2-010	ISED	0-6"	0.003
EAST TRIBUTARY	UD2-010	ISED	0-6"	0.010
	UD8-010	ISED	0-6"	0.000

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TABLE 4-18

RELATIVE PERCENTAGES OF CHLORINATED DIBENZODIOXIN AND
DIBENZOFURAN CONGENERS IN SURFACE WATER AND SEDIMENT SAMPLES

<u>CONGENER</u>	<u>DIOXINS</u>		<u>FURANS</u>	
	<u>SURFACE</u> <u>WATER</u>	<u>SEDIMENTS</u>	<u>SURFACE</u> <u>WATER</u>	<u>SEDIMENTS</u>
Tetra-	0%	0%	0%	0%
Penta-	0	0	0	1.9
Hexa-	0	<0.1	20.7	3.0
Hepta-	17.5	17.7	33.2	29.3
Octa	82.5	82.2	46.1	45.3